INSTRUCTION MANUAL
FOR MODEL NM-20B
RADIO INTERFERENCE AND
FIELD INTENSITY MEASURING EQUIPMENT

A Manufactured Product of the Electronic Research and Development Program of

STODDART
AIRCRAFT RADIO CO., INC.
6644 Santa Monica Boulevard
Hollywood 38, Calif. HOllywood 4-9292

Serving 33 Countries in Radio Interference Control

Date of Publication: January 1960

TABLE OF CONTENTS

	Page No.
SECTION 1 – GENERAL DESCRIPTION	
Scope of Instruction Book	1
Purpose and Basic Principles	1
Electrical Characteristics	1
SECTION 2 – THEORY OF OPERATION	
Introduction	3
General Theory of Operation	4
Circuit Analysis, Radio Interference-Field Intensity Meter NM-20B	5
The Weighting Circuits	7
Circuit Analysis, Power Supply 90780-2	8
The Pickup Devices	8
External Indicating Units	9
SECTION 3 – INSTALLATION	
Scope of this Section	11
Power Supply Requirements	11
Installation of Batteries	11
Initial Equipment Set-Up	11
Initial Adjustment	14
Transporting the Equipment	14
SECTION 4 – OPERATION	
Introduction	15
Equipment Controls and Receptacles	15
Description of Calibration Charts	17
Operating Instructions	17
Use as a Sensitive Radio Frequency Microvoltmeter	20
Survey Considerations	20
SECTION 5 – MAINTENANCE	
Introduction	25
Localization of Trouble	25
Removal of Chassis from Instrument Case	25
Radio Interference-Field Intensity Meter Trouble Shooting and Repair	26
Power Supply Trouble Shooting and Repair	27
Set-Up of Equipment for Alignment and Adjustment Procedures	27
Preliminary Checks Prior to Actual Alignment	27
Alignment and Adjustment Procedure	27
Correcting Calibration Charts After Alignment	32
SECTION 6 – PARTS LIST	35
LIST OF MANUFACTURERS	51

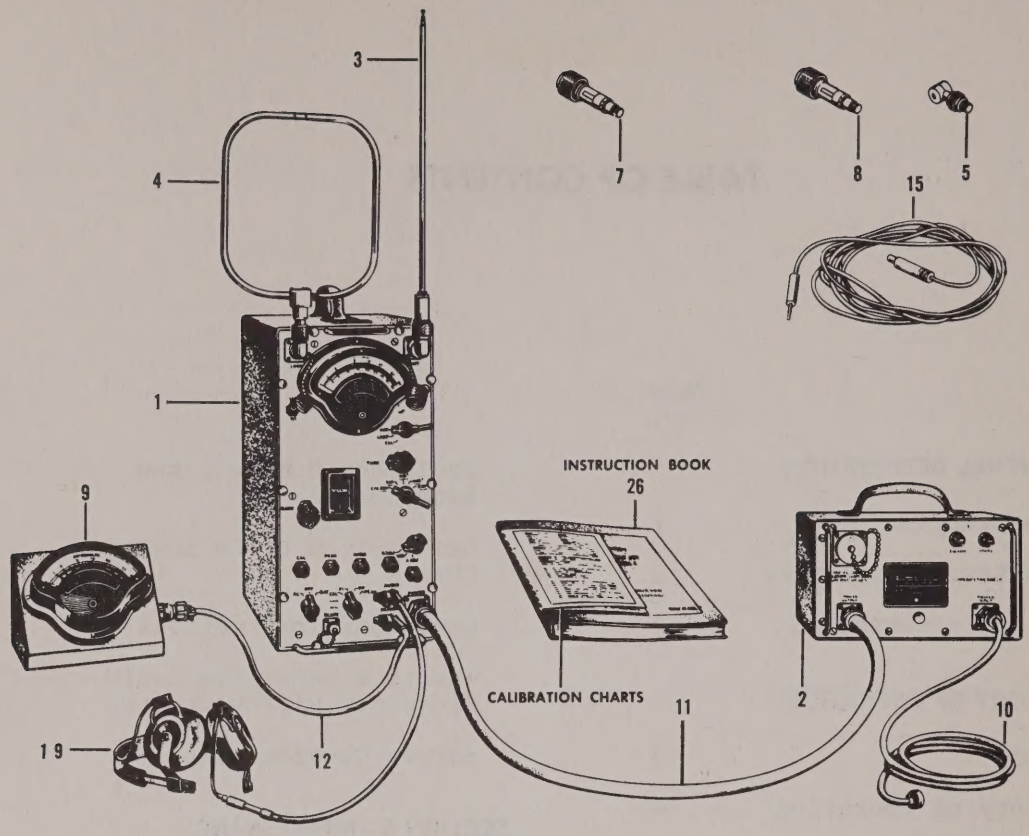


Fig. 1-1 NM-20B Major Equipment and Accessories:

ITEM	STODDART NUMBER	DESCRIPTION
1	NM-20B	Radio Interference-Field Intensity Meter, Frequency Range, 150 KC to 25 MC.
2	90780-2	Power Supply, AC
3	90291-2	Rod Antenna
4	90298-2	Loop Antenna, small
5	90185-2	Loop Probe
6*	91077-2	Loop Antenna, large
7	90305-4	Matching Impedance, General Purpose
8	90305-7	Matching Impedance, 50 ohms
9	90078-4	Remote Meter
10	91258-1	AC Power Cable
11	91487-1	Power Supply Cable
12	90075-2	Remote Meter Cable
13*	90048-2	Loop Cable
14*	90071-1	Oscilloscope Cable
*	Items not shown.	

ITEM	STODDART NUMBER	DESCRIPTION
15	90074-1	Headphone Extension Cable (20 ft)
16*	90303-2	Accessory Case (to contain items 2, 9, 10, 11, 12, 13, 14, and spare batteries)
17*	90731-2	Transit Case (to contain items 1, 3, 4, 5, 7, 8, 15, 19, 26, and leather carrying strap)
18*	90933-6	RF Transmission Line (6 ft)
19	10796	Headphones, 300-7000 cps response
20*	91160-1	Loop Calibration Network
21*	90095-2	Tripod (for NM-20B RI-FI Meter)
22*	90186-2	Tripod Bag(for item 21)
23*	11148	Low Pass Filter
24*	91550-1	RF Current Probe
25*	90078-10	Remote Meter, Slow Speed
26*		Instruction Manual

SECTION 1

GENERAL DESCRIPTION

1. SCOPE OF INSTRUCTION BOOK

NOTE

TO AVOID CONFUSION WITH AUDIO NOISE AND SOUND LEVEL METERS, REFERENCE IN THIS BOOK TO THE FAMILIAR "NOISE METER" WILL BE REFERRED TO AS THE RADIO INTERFERENCE-FIELD INTENSITY METER, ABBREVIATED RI-FI METER.

1a. This Manual has been prepared for the use of personnel concerned with the use and repair of the NM-20B Radio Interference-Field Intensity Meter. A thorough study of its contents is recommended.

2. PURPOSE AND BASIC PRINCIPLES

2a. The NM-20B can be used for radio interference surveys to determine the source of radiated or conducted interference from any source within its frequency range. Such interference may be generated by gasoline engines, generators, motors or electronic equipment. Field intensity measurement surveys may be made with the NM-20B for adjusting directive antennas or for exploring radiation patterns, where the field intensity may vary over a wide range of values. The equipment may also be used as a sensitive radio frequency microvoltmeter. The test set is portable and is suitable for mobile, field, or fixed operation.

2b. The NM-20B, hereafter referred to as the RI-FI Meter, and its accessories, which include a rod antenna, loop antennas, impedance matching devices, line probe, separate power supply, remote meter, graphic milliammeter recorder, and the necessary cables for connecting the accessories to the RI-FI Meter.

The RI-FI Meter is a highly sensitive radio receiver operating as a selective radio frequency voltmeter over the 150-kilocycle to 25-megacycle portion of the radio spectrum. It is capable of measuring voltages from one microvolt to one volt. As a field intensity measuring equipment, it is capable of measuring field intensities from two microvolts-per-meter to two volts-per-meter, depending on the antenna used.

Operation of the equipment is flexible due to the nature of the accessories supplied. The RI-FI Meter has a self-contained dry-battery pack to be used for short periods of operation. The separate alternating current power supply is used for longer or continuous periods of operation. In this instance, a source of alternating current power is required. The equipment can be operated on a bench, tripod or table, or simply placed on the ground. The rod and loop antennas connect directly to the RI-FI Meter front panel. Mounting provisions for these antennas are such that they mount vertically, whether the equipment is operated on the bench with front panel vertical or the equipment is operated on the ground with front panel horizontal.

Hand-held probes are connected to the RI-FI Meter input by means of a twenty-foot cable. When connected in this manner, the line probe is used for measuring conducted interference on power and transmission lines, and the loop probe and loop antenna are used for locating sources of radiated interference.

Signal monitoring provisions are available from panel-mounted headphone, oscilloscope, and external meter receptacles. Measurements are made using the panel-mounted meter or the remote meter. Graphic recordings can be obtained by connecting the Stoddart Milliammeter-Recorder 90097-2 to the extermal meter receptacle.

3. ELECTRICAL CHARACTERISTICS

3a. Frequency Range:

150 kilocycles to 25 megacycles in seven bands:

Band 1	150 to 320 KC
Band 2	320 to 750 KC
Band 3	750 KC to 1.75 MC
Band 4	1.75 MC to 3.8 MC
Band 5	3.8 to 8 MC
Band 6	8 to 15 MC
Band 7	15 to 25 MC

3b. Intermediate Frequency:

455 and 1600 kilocycles employed in the seven bands as follows:

Band 1	455 KC
Band 2	1600 KC
Band 3	455 KC
Band 4	455 KC
Band 5	1600 KC
Band 6	1600 KC
Band 7	1600 KC

3c. Selectivity:

The overall random noise bandwidth of the equipment varies from approximately two to seven kilocycles. Calibration charts give exact bandwidth figures for any frequency in the range.

3d. Image Rejection:

50 db or better.

3e. Intermediate Frequency Rejection:

50 db or better.

3f. Sensitivity:

(1) As a Two Terminal Voltmeter:

One microvolt. At two megacycles and above, the signal to noise ratio is unity or better and this sensitivity will be realized. At the lower frequencies a signal to noise ratio of unity cannot be realized due to design limitations.

(2) As a Field Intensity Meter:

With Antenna 90291-2, two microvolts-per-meter. The signal to noise

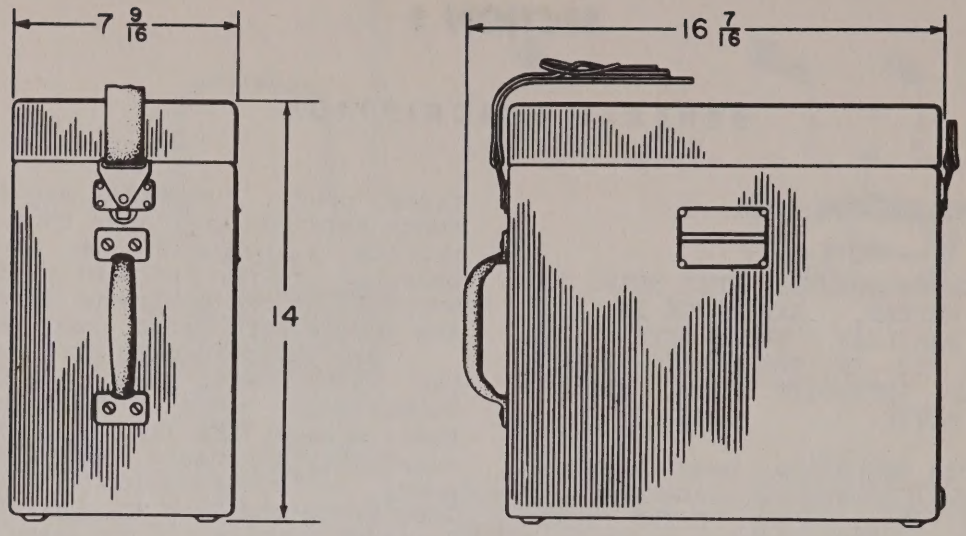


Fig. 1-2 Outline Dimensions, NM-20B Radio Interference-Field Intensity Meter

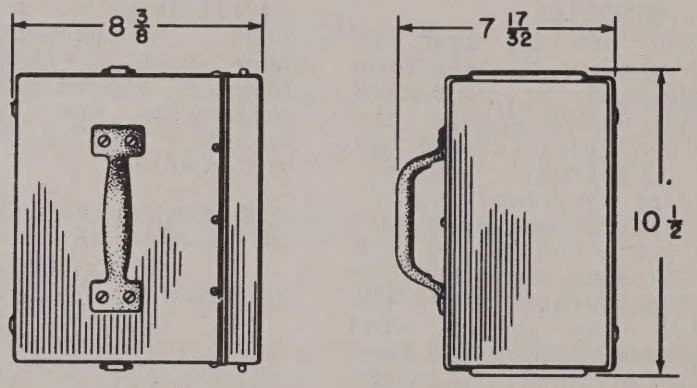


Fig. 1-3 Outline Dimensions, 90780-2 Power Supply

ratio considerations are the same as in (1) above.

3g. Audio Channel Output:

At least 100 milliwatts for 600-ohm output at 30% modulation at 1000 cycles, based on 10 microvolts RF input.

3h. Dynamic Range:

16 db dynamic range is the overload capacity and can be defined as the ratio of the highest sine wave voltage which may be linearly amplified in the last IF stage to the sine wave voltage at that stage required for full scale deflection of the meter, the AGC voltage being held fixed at its value for full scale deflection of the indicating meter. The dynamic range of this equipment is the ratio of radio frequency voltages of two different intensities within the frequency range of the equipment impressed in turn at resonance on the input of the equipment. The lesser of these two voltages is that which will produce full-scale deflection of the indicating meter. The greater of these two voltages is that which will produce an increase in detector output that causes a departure of exactly 10% from linearity. During the application of this greater voltage, the AGC voltage is held constant by independent means at the value obtained at full scale meter indication. This test is performed in all positions of the step attenuator, and the smallest ratio so obtained is taken as the dynamic range of the equipment.

3i. AC Power Requirements of Power Supply 90780-2:

(1) Voltage:
105-125 or 210-250.

(2) Phase:
Single.

(3) Frequency:
50-1600 cycles-per-second.

(4) Power Consumption:
25 watts.

(5) Power Factor:
87%.

3j. Batteries Required when AC is not available:

When the self-contained battery power supply is used, the following are required:

(1) Filament:
1.5 volts at .9 amperes; use two commercial type Burgess #4FH or equivalent.

(2) Plate:
90 volts at 0.030 amperes; use two Burgess #5308 or equivalent.

3k. Batteries Used at All Times:

(1) Bias.
9 volts; use two Burgess #5360 or equivalent. 1.5 volts; use two Burgess #2R or equivalent.

SECTION 2

THEORY OF OPERATION

1. INTRODUCTION

The NM-20B is used to measure the field intensity of a given radio transmission or to measure the intensity of radiated or conducted radio interference. Some reference to the nature of these quantities is given here with a brief description of the methods of measurement employed.

1a. The position of a transmitting antenna in space determines the polarization of the emitted wave. A vertical antenna radiates a wave consisting of a vertical electric field vector and a horizontal magnetic field vector. A horizontal antenna radiates a horizontally polarized wave consisting of a horizontal electric field and a vertical magnetic field.

A radiated field intercepted by a vertical antenna will set electrons in motion in the antenna. This electron flow constitutes a current that varies in accordance with the variations of the field. In this case the induced current in the antenna is not uniform but becomes zero at the top. The voltage effective in producing the current measured at the antenna base is equal to an effective height times the electric intensity of the field.

When a loop antenna is used, the magnetic component of the radiated field induces a voltage in the loop. The loop output voltage is a function of its shape, area, number of turns, and frequency of excitation.

Vertical and loop antennas may be used for field intensity measurements in the portion of the radio spectrum (.15 to 25 MC) under discussion. Field intensity is the value of the electric field at a given point and is measured in terms of volts-per-meter. One volt-per-meter is equivalent to a potential of one volt induced in an antenna having an effective length of one meter.

There are two principal methods of making field intensity measurements. One method is the substitution method in which a loop antenna is connected to a receiver and metering circuits give an indication of the receiver input. The receiver is tuned to the desired signal, the loop is rotated to give maximum signal, and then the indicated value of the received signal is recorded. The loop is then rotated to give minimum received signal, and a signal generator is inserted in series with the loop. The signal generator is tuned to the received frequency and its output adjusted to obtain the same reading of signal input as was obtained with maximum loop signal. The field intensity "E" is computed from the formula:

$$E = V/H(eff)$$

where V is the value of the substitute signal in microvolts. H(eff) is the effective height obtained from tables or computed as follows:

$$H(eff) = 1.351\ A\ N\ F\ x10^{-8}$$

where A = area of 1 turn of loop winding in square inches,
N = number of turns,
F = frequency in kilocycles, and
H(eff), is in meters.

NOTE

WHEN A VERTICAL ANTENNA IS USED FOR FIELD INTENSITY MEASUREMENTS, THE EFFECTIVE HEIGHT IS DETERMINED EXPERIMENTALLY BY COMPARISON WITH RESULTS OBTAINED WITH A LOOP.

The second method of field intensity measurement as employed in the NM-20B, uses a specially designed sensitive receiver with built-in attenuators and a comparison (calibrating) voltage source. The Radio Interference-Field Intensity Meter NM-20B is tuned to the desired frequency and the calibrating voltage is applied to the RF input. The gain of the equipment is then adjusted to give a standard value of calibrator signal input. The calibrating voltage is turned off and the antenna is connected to the RI-FI Meter input.

The attenuators are adjusted for a meter indication at the upper half of the indicating meter scale, and the meter reading thus obtained, times the attenuator setting and the effective height of the antenna used, is the field intensity in microvolts-per-meter of the received signal. This method is advantageous in that the accuracy is independent of signal frequency, and depends primarily upon the attenuator and the linearity of the RI-FI Meter input circuits.

1b. Radio Interference, sometimes called "noise", disrupts the utility of radio frequency receivers. Interference includes many forms of disturbances and may be roughly classified as continuous and discontinuous. Continuous disturbances include random interference such as thermal agitation. Atmospheric interference, or static, originating in lightning discharges in local storms and in more distant tropical storms, resembles random interference in that the impulses are frequent and overlap, with sharp peaks exceeding the average level. If interference impulses follow each

other rapidly and are not clearly distinguishable, the interference is considered random.

Discontinuous interference can be considered to be made up of sharp pulses, the pulse frequency determining the character of the interference. If the pulses are relatively infrequent and clearly separated, the interference is termed impulsive. Impulse interference may be generated by an internal combustion engine ignition system, power line discharges, motor brush sparking, electronic equipment, and by other electrical and electro-mechanical devices.

Because the frequency spectrum of continuous and discontinuous interference can be extremely wide, the interference magnitude will depend upon the bandwidth of the measuring equipment. For impulse interference, peak voltages are proportional to the bandwidth and average voltages are independent of the bandwidth. For random interference, both peak and average voltages are proportional to the square root of the bandwidth. If interference is determined to be largely impulsive or random, a correction factor can be determined by the following formulas and the factor applied to the meter reading:

$$\text{Random interference factor} = \sqrt{\frac{1000}{\text{Random Noise Bandwidth, cps}}}$$

$$\text{Impulse interference factor} = \frac{1000}{\text{Impulse Bandwidth, cps}}$$

The Bandwidth characteristics of the NM-20B are supplied in the calibration of the equipment and are utilized in obtaining interference readings in terms of a bandwidth one kilocycle wide. The procedure for interference measurement is similar to that of field intensity measurement. It is desirable to obtain average, peak and quasi-peak readings of interference in order to determine the type of disturbance.

NOTE

QUASI-PEAK MEASUREMENTS ARE MEASUREMENTS IN WHICH A FRACTION OF THE PEAK OF THE IF AMPLIFIER OUTPUT VOLTAGE IS DETERMINED, THE SIZE OF THE FRACTION BEING DIRECTLY PROPORTIONAL TO THE RATIO OF DISCHARGE TIME CONSTANT TO CHARGE TIME CONSTANT OF THE WEIGHTED DETECTOR CIRCUIT.

2. GENERAL THEORY OF OPERATION

2a. RF Input Devices:

Input devices for the NM-20B include a rod antenna, two loop antennas, a loop probe, a clamp-on current probe and impedance matching networks.

The meter scale is calibrated from 0 to 100 microvolts and from 0 to 40 db. The range of voltages under measurement depends on the setting of the attenuator switch and the type of RF input device used. The voltage range of the various RF input devices are:

Loop Antenna, Small 90298-2	10 to 100,000uv/M
Loop Antenna, Large 91077-2	2 to 20,000uv/M
Loop Probe 90185-2	1000 uv/M to 10 v/M
Rod Antenna 90291-2	2 uv/M to 2 v/M

It is to be noted that the rod antenna is a capacitive pickup device and measurements made with this antenna are affected by conductivity of the ground, nearby metal structures, and the body effect of the operator. For optimum accuracy when using the rod antenna, comparison measurements using the loop antenna and the rod antenna must be made at the frequency in use. The correction factor so obtained is then applied to the rod antenna meter reading.

Matching Impedance 90305-7 is a coupling unit to match the RI-FI Meter to antennas or networks of 50 ohms impedance. Matching Impedance (General Purpose) 90305-4 can be used to couple into relatively low-impedance sources.

2b. Radio Interference-Field Intensity Meter NM-20B:

The RI-FI Meter includes a highly sensitive radio receiver covering the 0.15 to 25 megacycle portion of the radio frequency spectrum. It also contains internal means for calibrating or standardizing its gain, thus permitting direct readings in indicated microvolts or microvolts-per-meter.

Measurements can be made with the RI-FI Meter in terms of the peak value of the signal or interference (the PEAK function of the meter), in terms of a weighted value (the QP (quasi-peak) function), or in terms of the average value (the FI (field intensity) function). The meter is standardized in the CAL position of the function switch and measurements are obtained by switching the function switch to the function desired.

The RI-FI Meter indicating meter scale is directly calibrated for a two-decade approximately logarithmic range of 1-100 microvolts (top scale), and an approximately linear 0-40 db (bottom scale) range.

The built-in attenuator provides full-scale values as follows:

CAL x X1	X10	$X10^2$
100 uv 40 db	1000 uv 60 db	10,000 uv 80 db

$X10^3$*	$X10^4$*
100,000 uv 100 db	1,000,000 uv 120 db

2c. Signal Channel In Radio Interference-Field Intensity Meter NM-20B:

Field Intensity Meter NM-20B:

The signal channel closely resembles a superheterodyne receiver in its RF, IF and AF portions, but differs from most superheterodyne receivers in its provision for attenuation and measurement of detector output.

The RF signal or interference (hereafter called signal for brevity) as picked up by the antenna or probe is delivered to the LOOP or ANTENNA receptacle at the RF input. The RF signal is amplified in the RF stage, and mixed with the local oscillator frequency in the mixer stage, to produce the intermediate frequency. The use of two intermediate frequencies (455 kc and 1600 kc) was necessary to obtain continuous frequency coverage from 150 kc to 25 mc. The IF signal is amplified in four IF stages, and demodulated in the detector stage. The demodulated signal is acted upon by the meter detector weighting circuits and applied to the VTVM stage, thus actuating the meter. The audio components are subsequently amplified and delivered to the headphone jacks.

The internal calibrator supplies a shot noise calibrating voltage that follows the same signal path from RF stage to indicating meter. With the calibrator on, the overall gain of the IF section is adjusted, by means of the CAL control, to the standardized signal level obtained from the Calibration Chart for the frequency of operation.

The built-in step attenuator provides the following step ratios: 1, 10, 100, 1000, and 10,000. Provision is made to obtain these ratios by discrete combination of attenuation in the antenna circuit and the first IF stage. Attenuation steps are tabulated below:

ATTENUATOR SETTING	AMOUNT OF ATTENUATION IN DB	
	RF	IF
CAL & X1	0	0
X10	0	20
$X10^2$	0	40
$X10^3$*	20	40
$X10^4$*	40	40

*These attenuator settings are not available for loop operation.

3. CIRCUIT ANALYSIS, RADIO INTERFERENCE-FIELD INTENSITY METER NM-20B

Individual circuits in the RI-FI Meter are described in the succeeding subparagraphs, with the exception of the detector weighting circuits. These circuits are treated separately in paragraph 4.

3a. Input Circuit:

Three switches in the input circuit are operated by one front panel input control. With the control set to the CAL position, S108 positively shorts out the loop input circuit at J101 to prevent undesired pickup. At the same time, S109 positively shorts out the rod antenna circuit at J102 to prevent undesired pickup.

In order to maintain tracking in all positions of the input control, the input switch S101 maintains a load across the loop and antenna primaries of the RF transformer input to the RF amplifier V101. In the CAL position of the input control, S101 connects the dummy loop L101 across the loop primary and the dummy antenna capacitor C108 across the antenna primary. In the LOOP position, the LOOP receptacle is connected across the loop primary and the dummy antenna across the antenna primary. The capacitor C108 simulates the rod antenna effective capacity. In the ANT position, the dummy loop is connected across the loop primary and the ANT receptacle J102 across the antenna primary. In this case, L101 and C235 maintain tracking by simulating the effective inductance and the distributed capacity of the loop and loop circuit winding respectively.

Two attenuator circuits are operated by one front panel control. The RF attenuator in the input circuit is a capacitive divider with shunt and series capacitors that provide one 20-db and one 40-db step of attenuation in the rod antenna input circuit only. The other attenuator is of the same type and precedes the IF amplifier circuits.

When the RI-FI Meter is operated with front panel facing up and the rod antenna is connected directly to J102, capacitor C196 is connected and simulates the capacity of the special right-angle adapter connector normally used between the rod antenna and J102.

3b. Antenna Stage and Calibration Diode:

The loop and antenna signals are inductively coupled to the tuned antenna circuits by separate primaries of the RF transformers. All unused antenna primaries are shorted and grounded by S103H and unused loop primaries are open-circuited by S103A. Unused tuned secondaries are shorted by S103B.

The RF amplifier V101 is a pentode amplifier with fixed grid bias of approximately 1.2 volts obtained from the voltage divider comprised of R130

and R133 on the "C" bias circuit. Capacitor C129 is a B+ blocking capacitor.

The shot noise diode V110 is connected across the high impedance grid circuit of V101 to supply the standardizing or calibrating voltage. Shot noise generated in the diode is a result of random variation in the number of electrons emitted from the filament of this thermionic tube. Because the space charge obtained in an electron tube under normal operating conditions reduces the shot noise voltage, the space charge is eliminated by lowering the filament temperature until the plate is attracting all of the electrons from the filament as rapidly as they are emitted. Under these conditions the plate current is dependent upon filament temperature and the shot noise component of plate current is proportional to the dc plate current flowing. The shot noise voltage has a uniform frequency distribution over the range of the NM-20B and requires no extra tuning control.

In the CAL position of the function switch the filament of V110 is connected to the filament voltage supply. The required plate current in the diode is obtained by adjustment of the back-of-panel ADJ DIODE R142 (in series with V110 filament) to obtain a meter reading between 20 and 100 microvolts on the meter scale. V110 is disconnected during BFO operation.

3c. Mixer Stage:

The plate signal of the RF amplifier V101 is coupled to the mixer V102 control grid through the tuned circuits of T108 when bandswitch S103 is set to band one. All tuned circuits for the unused frequency bands are shorted by S103C and S103D. Bias voltage for the injector grid of the mixer tube is obtained from the grid resistor R128 of the local oscillator tube.

3d. Local Oscillator Stage:

One half of a 3A5 duo-triode is used in an oscillator circuit with plate inductive feedback. The other half of the tube is not used. The feedback circuit for the frequency band in use is connected to V109 plate by S103E and the tuned circuit is connected to the control grid by S103G. Parasitic resistors R125, R126 and R127 are connected through S103F to unused oscillatory circuits in order to eliminate absorption by these circuits. The plate voltage supply to the local oscillator is filtered by the decoupling filter comprising R124 and C202. On all bands except Band 7, the local oscillator frequency is above the input signal frequency.

3e. First and Second IF Amplifier Stages:

The first and second IF stages are practically identical. The two stages differ only in the use of the IF attenuator circuit at the input to the first IF V103. The two stages, V103 and V104, are deciding factors in determining the operational characteristics of the VTVM at the receiver output. In this connection, operating potentials of the two stages are arranged so as to obtain a two-decade logarithmic meter scale on the meter. The screen potential for both tubes is adjusted by means of R110 to obtain meter scale tracking at the center of the range. AGC voltage is applied to V103 through the grid leak R111 and to V104 through L112 and L113 tuned circuits.

Two intermediate frequencies are used in the seven frequency bands as listed.

IF FREQUENCIES AND
LOCAL OSCILLATOR FREQUENCY

Band	IF Frequency	Local Oscillator Frequency
Band 1	455 KC	Above signal frequency
Band 2	1600 KC	Above signal frequency
Band 3	455 KC	Above signal frequency
Band 4	455 KC	Above signal frequency
Band 5	1600 KC	Above signal frequency
Band 6	1600 KC	Above signal frequency
Band 7	1600 KC	Below signal frequency

All IF stages have separate tuned circuits for each IF frequency, the appropriate circuits being selected by S104. One front panel band control knob operates S104 in the IF stages and S103 in the RF, mixer, and local oscillator stages.

IF transformers for both IF frequencies have approximately the same selectivity and gain characteristic s . The 455 KC coils are loaded by resistance. Factory adjustment of coupling permits performance approximately equalling that of the 1600 KC coils. In the first IF stage, capacitor C154 is a tuning capacitor common to the 455 and 1600 KC coils. Individual trimmer capacitors shunt each coil. The plate voltage supply to each IF stage is filtered by a decoupling circuit to reduce the common impedance between stages thus preventing regeneration.

The IF attenuator provides one 20-db step and one 40-db step of attenuation by means of capacitive dividers. In the XI position of the front panel attenuator control, no attenuation is inserted. The capacity of the attenuator network is simulated by C115 to maintain resonance.

In the X10 position of the attenuator control, resonance in the IF grid tuning is maintained by C111 and grid loading by R166. In this position C109 is the series and C112 the shunt element of the capacitive divider.

In the $X10^2$ position of the attenuator control, resonance in the IF grid tuning is maintained by C113 and grid loading by R167; C110 is the series

and C114 is the shunt element of the capacitive divider.

3f. Beat Frequency Oscillator:

A 3A5 twin-triode is used as the beat frequency oscillator for aural reception of CW signals. The audio signal is produced by heterodyning the IF signal frequency and the BFO frequency. The BFO switch must be placed in the BFO position to apply filament voltage to V114. When the switch is in this position, the indicating meter is disabled and no readings can be made. The BFO is not to be used for zero beating with the IF signal.

3g. Third IF Stage

The third IF stage is similar to the preceding stages with the exception of the addition of a gain control and screen grid stabilizing divider. The screen grid is stabilized by the voltage divider R116 and R169. Bias is obtained from the CAL potentiometer R133.

3h. Fourth IF Stage

The fourth IF stage is a power driver stage for increasing the dynamic range. The center-tapped filament of the 3V4 tube is connected in parallel for operation at 1.1 volts. Grid bias for the stage is obtained from a -4.5 volt battery.

3i. Detector Stage:

The 3A5 diode detector V107 demodulates the IF signal in a linear diode detector circuit. The diode output branches into two circuits--to the first audio stage V108, and to the AGC and VTVM circuits. That portion of the demodulated signal passing to the VTVM circuits will be known as the "dc" voltage, and that portion passing to the audio circuits will be known as the audio signal. It should be noted, however, that both portions of the diode output will originally contain both audio and dc components (corresponding to carrier intensity) if both were present in the received signal. The naming of dc voltage and audio signal is only for convenient reference purposes.

One important distinction constitutes a major difference in the audio and dc output of the detector. The audio signal drops its dc component (corresponding to carrier intenisty) at the coupling capacitor C197, while the dc voltage retains its dc and audio frequency components.

Two IF filter circuits comprised of C194 and L105, C193 and L104 filter out the IF signal.

3j. Audio Amplifier Stages:

The IU5 first audio stage V108 is connected in a pentode circuit using grid leak bias. Feedback is reduced by the by-pass capacitor C198 at the grid of V108. For use as a high impedance point for viewing the detector output, the output signal of V108 is brought out to the panel-mounted SCOPE receptacle (J104). In addition, V108 output is capacitively coupled to the grid of the audio output V113.

The 3V4 pentode V113, employed as the audio output stage, is connected as a voltage amplifier using -4.5 volts bias from BT104. The center-tapped filament of the tube is connected in parallel for operation at 1.1 volts.

Audio amplifier output is taken from output transformer T132 to the panel-mounted phone jack J103. The output level is adjusted by means of R121 in the input circuit to V108.

3k. The Vacuum-Tube Voltmeter Stage:

Two 3V4 pentodes are employed in the VTVM stage, which is a circuit adaptation of the familiar balanced VTVM circuit. The dc voltage to be measured is applied to the grid of V112 and upsets the balance of the stage, causing the indicating meter M101 to deflect upscale and indicate the magnitude of the unbalance.

The use of this balanced VTVM circuit counteracts the effect of supply voltage variation since supply variations will affect both tubes equally,and the resulting change in meter indication due to supply voltage variation will be small.

Initial bias obtained from BT101 and the voltage divider consisting of R137, R136 is used on the grid of V112. Bias for V111 is obtained from BT103 and the voltage divider consisting of R151, R152. The METER ZERO control (R152), adjusts the bias on V111 for balancing. Balance is indicated by a zero reading of M101 when no signal input is present. The 100 ADJ control (R147) in series with M101 is a volt-meter sensitivity control adjusting the meter scale tracking at full scale.

RF pickup by cables connected to the closed circuit jack J106 is filtered by C232.

4. THE WEIGHTING CIRCUITS

NOTE

THE TERM "WEIGHTING" AS APPLIED TO THE EQUIPMENT SPECIFICALLY REFERS TO THE TIME CONSTANT INTRODUCED IN THE DETECTOR AND AGC CIRCUIT. THIS "WEIGHTING" EFFECTIVELY DETERMINES THE TIME VS. VOLTAGE CHARACTERISTICS OF THE INDICATION OBTAINED.

The weighting circuits are selected by the function switch S105 and serve to properly weight the voltage supplied to the indicating meter for the three types of measurements performed by the equipment. The weighting circuits also determine the AGC time constant.

4a. The Field Intensity Circuit:

The AGC and VTVM circuits see a voltage source which charges slowly and discharges slowly so that the meter indication shows an average of the input signal over 600 milliseconds continuously.

The meter reading for field intensity is proportional to the field intensity of radiated signals, or proportional to the averaged value or RF interference. The reading will be independent of modulation in the case of modulated CW signals due to the filtering section of L104, C193, and C194.

The voltage picked off R139 applies a bias to V107 which counter- acts the contact potential of the diode.

The meter is accurately standardized in the field intensity position against the shot noise source to obtain a previously calibrated standard meter reading. Direct meter readings on random interference are then available, and are converted to "microvolts-per-kilocycle-of-bandwidth" by the use of Calibration Chart.

4b. The Quasi-Peak Circuit:

In the quasi-peak function, the time constants of the detector weighting circuits approach one millisecond charge and 600 milliseconds discharge. The meter indication then is near the peak value of an interfering signal, including pulsed signals with PRF as low as 300 pulses-per-second.

QP control (R140) accomplishes the same results as R139 described under paragraph 4a. A separate potentiometer is employed because the actual bucking potential is different than that required in the field intensity position of the function switch due to the different diode loads. Quasi-peak meter indications are adjusted to be the same as those in the field intensity function, using the same unmodulated signal, by adjustment of the PEAK full-scale control (R129).

4c. The Peak Circuit:

In the peak function, the circuit is similar in some respects to the field intensity circuit described in paragraph 4a. The VTVM and AGC circuits are the same, but an additional bias circuit BT103, BT104, and R132 has been added to enable the measurement of peak signal values. The peak value measured is the "peak" as seen by the second detector and not the true peak of the signal at the antenna input. The PEAK position of the function switch applies a dc voltage in parallel with the signal input. The circuit is similar to an adjustable delayed AGC system, since the dc voltage is also applied to the detector V107. The dc voltage is manually adjusted to the threshold of diode rectification. This measurement technique is similar to that employed in the "slide - back" voltmeter. For any given measurement at the low end of the meter scale, the PEAK ADJ control (R135) equalizes the meter reading obtained in the PEAK position of the function switch with that obtained in the field intensity position.

5. CIRCUIT ANALYSIS, POWER SUPPLY 90780-2

5a. Power Supply 90780-2 is designed for operation from any AC power source within the limits of 105-125 and 210-250 volts, and at any frequency between 50 and 1600 cycles per second. The power selector switch, S302, located on the chassis, must be set to the appropriate 115 or 230-volt position.

The power transformer T302 contains three sections -- an autotransformer, a power transformer and a filter choke. When a 115 volt power source is used the primary circuit includes the thermal regulator R305, the primary of the power transformer section of T302 (terminals 1 and 2), and the power switch S106 in the RI-FI meter. By action of R305, regulated 80 volts is maintained across the primary of the power transformer.

Regulated 115 volts from the secondary of T302 (terminals 4 and 5) is applied to the bridge-connected selenium rectifier CR301. The series circuit comprised of R302, V302 and the coil of K301 is connected across the rectifier output. Gas tube V302 conducts when the rectifier output is initially 105 volts. This energizes the relay, which applies the load circuit. Once conduction in V302 has taken place, however, the voltage drop across the tube rapidly falls to 75 volts, and is held at that level by the regulating action of the tube.

Approximately 8 volts from the secondary of T302 (terminals 6 and 7) is impressed across the bridge-connected rectifier CR302. Its output is filtered by the two-section filter L301A/B and C304 and C305. The bleeder resistor R303 is adjusted to provide 1.1 volts for the filaments of all tubes.

When a 230-volt power source is used, the line voltage is reduced to 115 volts by action of the autotransformer section of T302 (terminals 10, 11 and 12).

6. PICKUP DEVICES

6a. Rod Antenna:

Antenna 90291-2 is a telescopic vertical rod antenna with an effective length of approximately one-half meter and a physical length of 41 inches. The twin-axial connector at the base of the antenna connects with ANT receptacle J102 on the RI-FI Meter panel when the unit is operated with panel facing up. When the panel is vertical, the rod antenna is connected to the right-angle adapter, which in turn is connected to J102.

6b. Loop Antennas:

The Small Loop Antenna 90298-2 is a shielded loop with rectangular shape and an equivalent diameter of 8-1/4 inches. It is connected to the LOOP receptacle on the RI-FI Meter or may be used as a hand-held probe connected to the end of the twenty-foot cable.

The Large Loop Antenna 91077-2 also is a rectangular shielded loop with an effective area of approximately 496 square inches providing a 5 times increased sensitivity. Mounting is the same as the Small Loop Antenna.

6c. Loop Probe:

The hand-held probe Antenna 90185-2 is connected to the LOOP receptacle J101 by means of the twenty-foot cable. It can be rotated on its base to utilize the directional characteristics of the loop.

6d. Line Probe:

The Line Probe 90093-4 permits use of the RI-FI Meter as a two-terminal voltmeter, for measurement of conducted interference on a line. Access to two spring-type binding posts at the probe input is gained by means of a sliding cover on the probe shield. In use, short insulated jumpers are connected to the probe input and the free ends of the jumpers are connected to one side of the line and to ground. Capacitors C401 and C402 insulate the probe for potentials up to 1000 volts ac. Interference or signal voltages developed across the load consisting of R403 and R404 appear at the output J403.

Calibration curves for Line Probe 90093-4 are included in the Calibration Chart.

6e. Matching Impedance Networks:

Two matching impedance networks are supplied. Except for circuit impedance, both are physically identical. They are connected to the ANT receptacle J102 where they present a capacitive reactance equivalent to that of the rod antenna. The type "N" input connector of each unit mates with the "N" male connector usually used on test equipment, and coaxial RF transmission lines.

The 50-ohm unit, 90305-7 is intended for use where it is desirable to terminate a transmission line, an antenna, or other circuits in this resistance value at the input to the RI-FI Meter. The unterminated unit, 90305-4, is intended for use with signal generators or other devices whose output is not meant to be terminated in a low resistance.

6f. Current Probe:

The 91550-1 Current Probe enables the accurate measurement of conducted radio interference currents in the frequency range of 15 kilocycles to 100 megacycles. Measurement can be made on single conductor and multi-conductor cables, grounding and bonding straps, and on the external surfaces of shielding conduits and coaxial cables.

7. EXTERNAL INDICATING UNITS

The Remote Meter 90078-4 is identical to the internal meter M101 in the RI-FI Meter. The Remote Meter or a suitable milliammeter-recorder can be connected in series with M101 by means of EXT METER receptacle J106. The external meter can be used simultaneously because the receptacle is wired so that the external unit has little effect on M101. There is no effect as long as the resistance of the external meter is 1500 ohms. If an external meter other than Remote Meter 90078-4 is used, and its resistance is not 1500 ohms, extra resistance must be added as required.

NOTE

THE A AND B VOLTAGES CANNOT BE CHECKED WITH THE EXTERNAL METER.

Slow Speed Remote Meter 90078-10 is physically similar to the Remote Meter 90078-4. The slow speed remote meter has a movement response time between 2 and 3.5 seconds. It is intended to average the output of the quasi-peak measuring circuit over a longer period of time than the general purpose output meter. On steady noises it reads the same as the general purpose output meter after the pointer reaches its rest position. On noises characterized by irregularly superimposed and widely spaced noise peaks which cause erratic readings of the general purpose meter, the slow speed meter should be used. The slow speed meter eliminates these erratic effects and reads the steady noise.

SECTION 3

INSTALLATION

1. SCOPE OF THIS SECTION

1a. Procedures for setting up the NM-20B for operation are given in this section. Actual operating procedures are given in the following Section 4.

NOTE

NO PROVISIONS ARE MADE FOR PERMANENT MOUNTING

2. POWER SUPPLY REQUIREMENTS

The NM-20B uses self - contained plate and filament voltage batteries for limited periods of operation. In general, however, the equipment will be operated with an external power source supplying power to Power Supply 90780-2. The external power source must be rated at 105 to 125 or 210 to 250 volts ac, single phase, with frequency within the range of 50 to 1600 cps. Power consumption is 25 watts at 115 volts, 60 cps.

At all times, including periods when an ac power supply is used.two 4.5-volt and two 1.5-volt bias voltage batteries are required. No batteries are shipped with the equipment.

CAUTION

DO NOT OPERATE ON AC WITHOUT BIAS BATTERIES

3. INSTALLATION OF BATTERIES

The battery complement of eight batteries is listed in Section 1, paragraphs 3j and 3k.

To install batteries, place the RI-FI Meter so that its panel is facing up and loosen the ten captive knurled screws on the front panel. Lift the chassis out of the case, invert the chassis and stand it up on the front panel guard handles.

CAUTION

TO AVOID DAMAGING THE SPRING GROUNDING STRIP WHICH IS AT THE INNER EDGE OF THE CASE FLANGE, ALWAYS PLACE THE RI-FI METER SO THAT THE PANEL IS FACE UP AND LIFT THE CHASSIS STRAIGHT UP. WHEN REPLACING THE CHASSIS, ALWAYS LOWER IT INTO THE CASE VERY CAREFULLY.

The filament and plate batteries are located in a compartment at the rear of the chassis. Remove the four knurled screws that fasten the battery cover at the back of the chassis and remove the cover. Place two filament and two plate voltage batteries in the battery com - partment. Each battery lead is clearly identified by a circular tag. Make the proper connections and replace the battery cover.

Two 4.5-volt bias batteries are located on the right side of the chassis. Remove the two flat head screws that retain the battery bracket and remove the bracket. With the battery terminals oriented, and the batteries in a position to be retained by the bracket, replace the bracket and mounting screws. Connect battery leads to battery terminals.

NOTE

THE BAKELITE RETAINING BAR HAS AN ECCENTRICALLY LOCATED MOUNTING HOLE TO ALLOW FOR VARIATION IN BATTERY SIZES

The 1.5-volt cells are mounted in clips on the left side of the chassis. Remove the knurled nut and retaining bar across the clips. Press the cells into place with positive(or center) terminal facing toward the chassis center. Replace the retaining bar and knurled nut.

To reassemble the RI-FI Meter in its case, lower the chassis into the case, taking precautions not to damage the spring seal at the edge of the case. Hand tighten the ten knurled captive screws on the front panel.

4. INITIAL EQUIPMENT SET-UP

4a. General:

The allocation of units and accessories to each carrying case has been planned so that the necessary equipment for surveys of limited scope are carried in the transist case. The remaining accessories for maximum utility of the equipment are carried in the accessory case.

The type of measurement to be made will determine the choice of antenna, matching impedance network or probe.For the measurement of radiated energy in interference and field intensity surveys use the rod and loop antennas. For measuring conducted interference on power lines etc.,use the line probe,and for measuring interference on radio frequency transmission lines use the appropriate matching impedance network.

The hand-held Loop Probe, 90185-2 is provided for use in restricted spaces to locate sources of radiated energy. It is used on the end of 20' 0" Loop Cable 90048-2, and is arranged to rotate about its axis for orientation to the plane of maximum or minimum pickup or inductiv e coupling.

The Loop Antennas,90298-2 or 91077-2,can also be used as a hand-held probe. In this case, Adapter Connector 10330 must be connected to the connector at the base of the loop and to the free end of cable 90048-2.

4b. Limited Set-Up:

No cables are used when setting up the equipment carried in the transit

case. The equipment is assembled as follows:

Step 1. Place the RI-FI Meter on a convenient bench, tripod 90095-2, or other flat operating surface with the front panel in a vertical plane. Remove the protective cover for access to the front panel.

Step 2. From inside the protective cover take the Adapter connector 90723-1 and the Rod Antenna 90291-2 from the ferrule clips. Connect the Adapter Connector 90723-1 to the ANT receptacle on the front panel and then connect the rod antenna to the Adapter Connector 90723-1. Take the Adapter Connector 10165 and Loop Antenna 90298-2 from the ferrule clips in the protective cover. Connect the Adapter Connector 10165 to the LOOP receptacle on the front panel and then connect the loop antenna to the Adapter Connector 10165.

NOTE

THE LOOP AND ROD ANTENNAS MAY BE USED WITHOUT THE ADAPTER CONNECTORS IF IT IS DESIRED TO OPERATE THE EQUIPMENT WITH THE PANEL HORIZONTAL, SUCH AS WOULD BE NECESSARY IF THE SITE WERE COVERED WITH WATER OR MUD.

Step 3. Remove the calibration charts from the protective cover for reference during operation.

Step 4. Plug the headphone into the AUDIO receptacle on the RI-FI Meter front panel.

Step 5. For measuring conducted energy on radio frequency transmission lines or for connecting the RI-FI Meter to a signal generator, remove the appropriate matching impedance network from the transit case and connect it to the ANT receptacle on the front panel. The input receptacle of each matching impedance network mates with a type "N" connector usually used on test equipment and coaxial radio frequency transmission lines at these frequencies.

4c. Full Scale Set-Up:

The full scale set-up of the NM-20B expands the previously described limited setup by use of the separate power supply, remote meter, hand-held probe, and line probe, together with associated cables.

Step 1. Connect the power supply cable 91487-1 between the POWER OUTPUT receptacle on the power supply 90780-2 and the POWER receptacle on the RI-FI Meter.

Step 2. Connect the ac Power Cable 91258-1 to the POWER INPUT receptacle on the Power Supply.

Step 3. Connect the Loop Cable 90048-2 to the receptacle on the Loop Probe 90185-2. Connect the other end of the cable to the LOOP receptacle on the RI-FI Meter after removing the rectangular Loop Antenna 90298-2.

NOTE

THE POWER SUPPLY MAY BE OPERATED IN ANY POSITION INSOFAR AS ELECTRICAL AND MECHANICAL PERFORMANCE IS CONCERNED. HOWEVER, WHEN THE SITE IS COVERED WITH WATER OR MUD, OPERATE THE POWER SUPPLY WITH PANEL FACING UP.

Step 4. To use Radio Test Set NM-20B as a two-terminal voltmeter for measuring signals or interference on a balanced line, connect the Line Probe 90093-4 to the LOOP receptacle on the RI-FI Meter by means of Cable 90048-2. Push open the sliding cover on the probe and secure an insulated jumper to each of the two binding posts thus exposed. Insert the jumpers through the two holes in the end of the probe. Connect the free ends of the jumpers to the line on which interference is to be measured. After connections are made, close the sliding cover.

CAUTION

AVOID SHARP BENDS IN THE RG-22A/U CABLE FROM WHICH CABLE 90048-2 IS FABRICATED. UNDER THE PRESSURE OF SHARP BENDS, THE TWIN-AX CONDUCTORS WORK THROUGH THE SOMEWHAT ELASTIC INSULATING MATERIAL TOWARD THE WALL OF THE CABLE. THIS IS KNOWN AS "COLD FLOW" AND IS A CHARACTERISTIC OF FLEXIBLE RADIO FREQUENCY CABLES. SUCH CABLES MUST BE USED WITH CARE. EXTREME BENDS MAY CAUSE THE CONDUCTORS TO SHORT-CIRCUIT AND CAUSE THE NORMAL CAPACITY-BALANCE OF THE LINE TO BE UPSET.

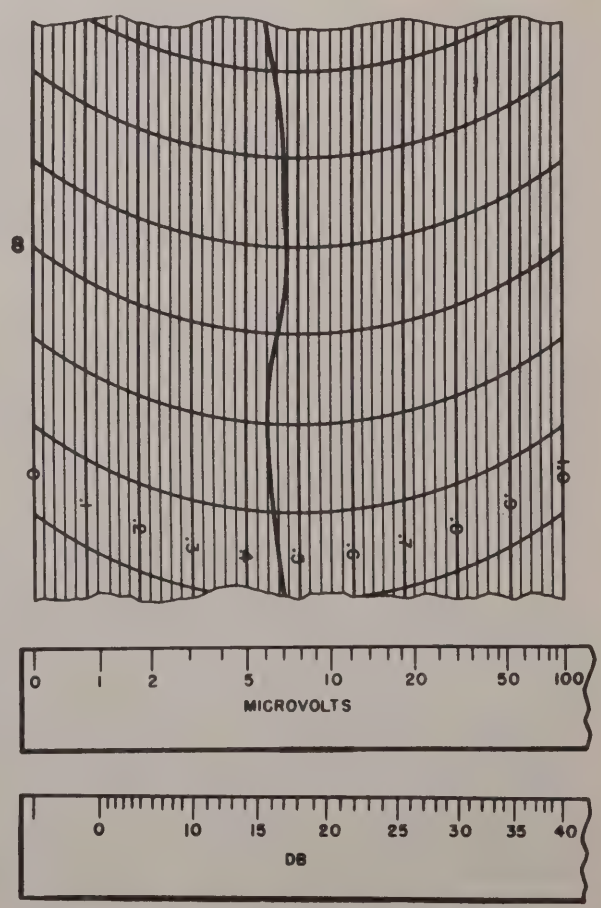


Fig. 3-1 Esterline-Angus Recorder, Inspecting the Record

Step 5. For remote meter indications, connect the remote meter cable between the receptacle on the side of the remote meter and the EXT METER receptacle on the RI-FI Meter front panel. When the remote meter is used, it is desirable to use the headphone extension cable. Plug the headphones into the female receptacle on the extension cable 90074-1 and the other end of the cable to the AUDIO receptacle on the RI-FI Meter.

If graphic records of signal measurement are desired, the Esterline-Angus Milliammeter Recorder 90097-2 or equivalent can be used. The meter movement in the recorder operates a pen element that moves along the scale for visual indication and inks a moving chart paper. A 115 volt ac 60 cps synchronous motor operates the recorder chart drive.

The procedure to calibrate a chart ruler is as follows:

Turn the recorder on. Adjust the PEAK control on the RI-FI Meter so that an indication of 1 microvolt appears on the RI-FI Meter Scale. Allow sufficient time to have the recorder pen mark a 1/4 inch vertical line on the chart paper. Use the same procedure to obtain vertical markings on the graph paper corresponding to the major points on the RI-FI Meter Scale (2, 5, 10, 20, 50 and 100 microvolts).

With the recorder off, place the plastic strip across the recorder chart. Score the strip at the positions of the vertical lines. These marks should be identified with the corresponding meter scale markings. The plastic strip can similarly be calibrated in db readings using the RI-FI Meter as a reference.

For further information on the use of the recorder, consult the manual supplied with the Esterline-Angus Recorder.

NOTE

IN ORDER TO MAINTAIN A CLOSED VTVM CIRCUIT, ASCERTAIN THAT THE PROPER REMOTE UNIT IS CONNECTED TO THE CABLE 90075-2 WHEN THE LATTER IS PLUGGED INTO THE RI-FI METER EXT METER RECEPTACLE. THE VTVM CIRCUIT IS OPENED WHEN A PLUG IS INSERTED IN THE RECEPTACLE, PLACING THE CIRCUIT ASSOCIATED WITH THE CABLE IN SERIES WITH THE INTERNAL VTVM.

Step 6. When it is desired to observe the detected waveform of an interference signal, connect an oscilloscope to the SCOPE receptacle on the RI-FI Meter using the low capacity oscilloscope Special Purpose Cable 90071-1.

4d. Connecting to External Power Source:

NOTE

BE CERTAIN TO TURN THE AC-OFF-BAT POWER SWITCH S106 ON THE RI-FI METER TO THE OFF POSITION BEFORE CONNECTING THE EQUIPMENT TO AN EXTERNAL POWER SOURCE.

(1) POWER SUPPLY 90780-2: The external power source for the Power Supply may be either 105-125 or 210-250 volts ac, 50-1600 cycles-per-second. To accomodate either voltage source, the power switch S302 on the chassis of Power Supply 90780-2 must be set to the appropriate high or low voltage position. The "in-use" position of this switch is indicated by means of a metal reminder tag on the front panel to the left of POWER INPUT J301. This tag covers one-half of the panel legend reading "115V 230V". Check that the exposed portion of the legend agrees with the power source voltage to be used. If the 115V position of S302 is indicated and a 230-volt source is contemplated, first loosen the fourteen screws on the supply front panel. Remove the ten screws at the sides of the power supply case. Slide the case off the chassis. Set toggle switch S302 on the chassis to the 230-volt position. In order to properly seal the power supply when reassembling, slide the case over the chassis and start the ten screws in the sides of the case. Invert the power supply so that the panel is up. Loosen the fourteen screws at the edges of the front panel. Tighten the ten screws at the sides of the case. Now tighten the fourteen screws on the front panel. Turn the power supply and loosen the screw that fastens the reminder tag. Rotate the tag 180 degrees to cover the 115V portion of the legend. Tighten the screw.

(2) Connect a good ground to the third conductor of Power Cable Assembly 91258-1, J108 on the RI-FI Meter, or J303 on Power Supply 90780-2. Only one unit or the power cable should be grounded because grounding more than one creates a loop in conjunction with the interconnecting cable. Make sure the case of ungrounded units is not inadvertently grounded by placing it on the earth or on a grounded metal frame.

4e. Connecting to External Batteries:

In the event no external ac power source is available and the length of contemplated operating periods makes the use of the internal batteries uneconomical, external batteries may be used for the power source. This requires the assembly of a battery cable for connection to the POWER receptacle J108 on the RI-FI Meter. When external batteries are so connected to the RI-FI Meter, the power selector switch S106 must be in the AC position to start the equipment.

Make up a battery cable using connector plug 10192. Connect the 75-volt plate voltage to terminal A, the 1.2-volt filament voltage to terminal B, and the common negative to terminal C.

The normal filament current is approximately 0.9 amperes. If a group

of dry cells in parallel is used for the A supply, no external resistor is required. For operation on a two-volt storage cell, use a one-ohm dropping resistor. For operation from a six-volt storage battery, use a five-ohm dropping resistor. The dropping resistors should be wirewound, ten watts.

The normal B current is approximately 32 milliamperes. Two large 45-volt batteries in series may be used. However, better regulation will be obtained when the actual B battery voltage is no more than the value required to bring the voltage to the red mark on the meter scale when the B ADJ control is nearly at a maximum clockwise position.

5. INITIAL ADJUSTMENT

5a. Electrical Adjustments:

All internal alignment and calibration adjustments on the RI-FI Meter are made at the factory and no further adjustment is required in the field prior to operation.

6. TRANSPORTING THE EQUIPMENT

6a. Packing in Carrying Cases:

Safe storage for each unit and accessory of the NM-20B is provided in the two carrying cases supplied. These cases are adequate packing for transporting the equipment from one survey site to another. The carrying cases are drip-proof, but were not designed to withstand severe exposure to the elements. Cases should be covered with tarpaulin when left in the open over night.

NOTE

WHEN REPLACING THE PROTECTIVE COVER ON THE RI-FI METER THE AC-OFF-BAT SWITCH MUST NOT BE TURNED TO THE BAT POSITION. A STUD MOUNTED IN THE COVER PREVENTS INSTALLING THE COVER UNLESS THE SWITCH IS IN THE AC OR OFF POSITION. IN ORDER TO AVOID SHORTS OR DAMAGE TO THE BATTERY TERMINALS, PLACE THE SPARE 45-VOLT BATTERIES IN THE ACCESSORY CASE WITH THE BATTERY TERMINALS FACING THE SIDES OF THE CASE.

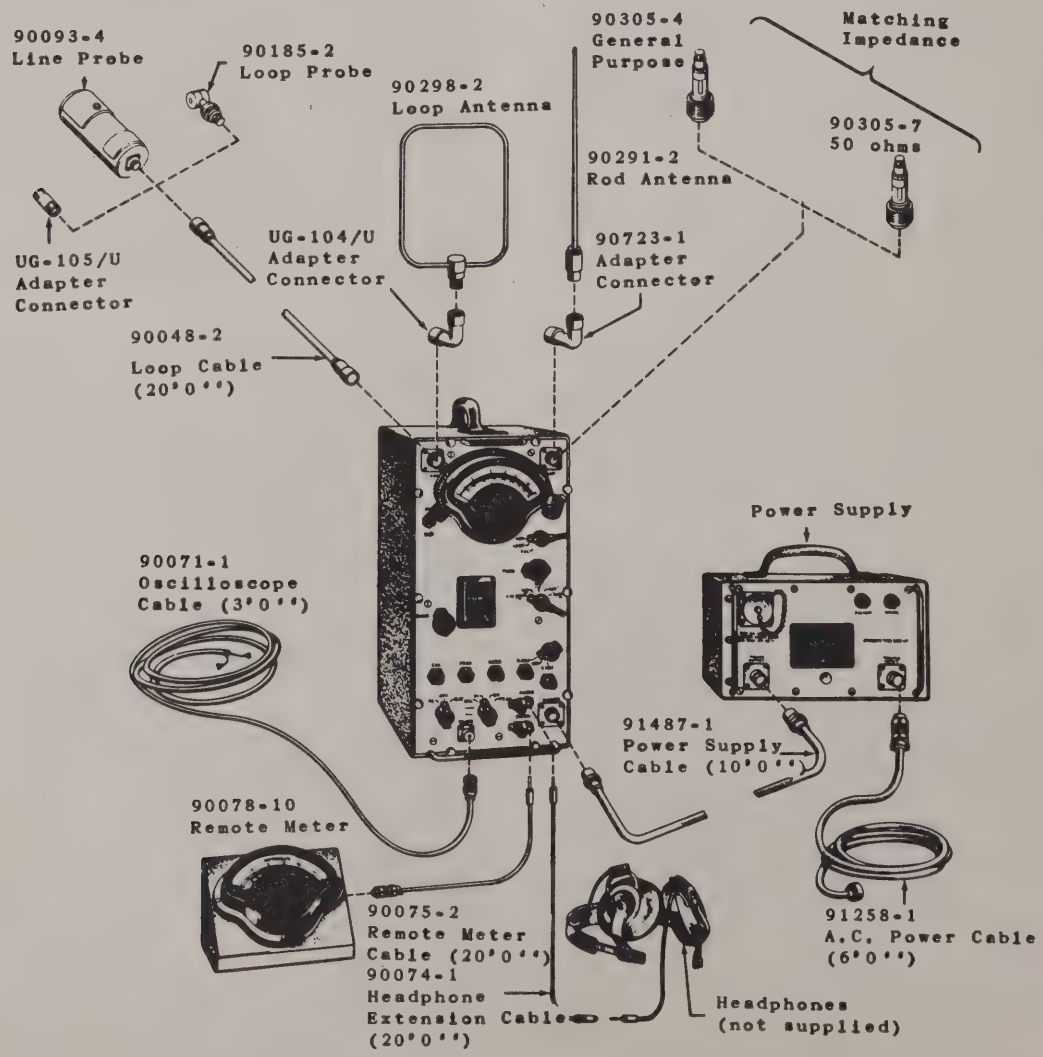


Fig. 3-2 Radio Test Set NM-20B Cabling Diagram

SECTION 4

OPERATION

1. INTRODUCTION

1a. General:

The NM-20B is basically a meter intended for intensity measurements of all types of radio frequency energy from 150 kilocycles to 25 megacycles.

The NM-20B includes a sensitive receiver and a vacuum-tube voltmeter (VTVM) section. It also contains internal means for standardizing the receiver gain, thus permitting direct reading in indicated microvolts or microvolts-per-meter.

Provision has been made for use of the equipment in the following ways:

(1) As a field intensity measureing equipment operating from a vertical antenna of convenient size.

(2) As a field intensity measureing equipment operating from a loop antenna with directional properties.

(3) As a field intensity measureing equipment operating from a small probe responsive to an induction field.

(4) As a two-terminal voltmeter making both symmetrical and asymmetrical measurements with respect to ground.

With the various input provisions incorporated in the system RF voltages from one microvolt to one volt may be measured. In terms of field intensity, two microvolts-per-meter to two-volts-per-meter may be measured, depending on the type of antenna used.

In operation, the type of measurement is selected by means of the function switch. The FI (field intensity) function of the meter affords measurement in terms of the average value, the QP (quasi-peak) function derived by the use of a weighted detector circuit, and the PEAK function in terms of the peak value effect of the signal or interference at the second detector.

The RI-FI Meter measures the effect of the peak value of an interfering pulse. It does not measure the absolute peak value of the pulse because such response is dependent upon the effective bandwidth, the energy of the impulse (product of amplitude and duration), and the second detector characteristics of the measuring equipment. The duration of the impulse, after passing through the various tuned circuits, is roughly proportional to the reciprocal of the RI-FI Meter effective bandwidth. The envelope of the pulse applied to the second detector differs from the input impulse envelope. Its peak amplitude is less than that of a sine wave signal having the same peak value as the original impulse. The tuned circuits in the RI-FI Meter shape the pulse so that its peak amplitude is decreased and its duration is lengthened. The RI-FI Meter integrates the spectrum of the impulse over the pass-band around the signal frequency and measures the peak value of the shaped impulse. This value can be converted to a per-kilocycle-bandwidth basis by application of a factor depending upon the bandwidth of the RI-FI Meter at the measured frequency. When expressed in terms of per-kilocycle-bandwidth, the result may be correlated with similar readings obtained from other measuring equipments expressed in the same units.

2. EQUIPMENT CONTROLS AND RECEPTACLES

2a. The operating controls of the NM-20B are all located on the front of the equipment. Likewise, the receptacles to which external connections are made are also on the front panel.

The function of each control and receptacle is briefly described by an adjacent panel marking or by panel markings identifying the various control positions.

DESIGNATION AND FUNCTION OF PANEL CONTROLS AND RECEPTACLES ON THE RI-FI METER

LEGEND	FUNCTION
LOOP (J101)	Loop antenna, loop probe, and line probe input.
ANT (J102)	Rod antenna input; asymmetrical input using Matching Impedance Networks.
GND (E122)	External ground.
Input Control (S101, S108, S109)	
CAL position	Used when adjusting for standard meter indication.
LOOP position	Used for measurements with loop antenna input to the equipment.
ANT position	Used for measurements with rod antenna input to the equipment.
TUNE (C120)	Operates three-section tuning capacitor to vary tuning of antenna, local oscillator, and mixer stages.

LEGEND (Cont'd)		FUNCTION (Cont'd)
BFO (S112)		Places beat frequency oscillator in operation for CW reception. BFO not used in making measurements since indicating meter is disabled when switch is in BFO (on) position: used only for identification of signals.
OFF		Disables BFO circuit
Attenuator Control (S102, S110)		
CAL & X1	0 DB	Passes signal unattenuated.
X10	+20 DB	Attenuates signal 10 times or 20 db.
$X10^2$	+40 DB	Attenuates signal 100 times or 40 db.
$X10^3$	+60 DB	Attenuates signal 1000 times or 60 db. Not used with loop input to the equipment.
$X10^4$	+80 DB	Attenuates signal 10,000 times or 80 db. Not used with loop input to the equipment.
METER (S107)		
"A" ADJ position		Connects indicating meter for filament voltage check.
USE position		Connects indicating meter to VTVM circuit for interference and field intensity measurements.
"B" ADJ position		Connects indicating meter for plate voltage check.
BAND (S103 and S104)		Selects tuned circuits in antenna, local oscillator and mixer stages for seven frequency bands and selects applicable IF for each band.
CAL (R133)		Standardizes overall gain.
PEAK (R132)		Provides slide-back voltage for measuring peak voltages.
AUDIO (R121)		Controls aural (headphones) monitoring level.
"B" ADJ (R146)		Adjusts plate voltage to proper operating level for which red mark on meter scale has been calibrated.
"A" ADJ (R145)		Adjusts filament voltage to proper operating level for which red mark on meter scale has been calibrated.
Power Switch (S106)		
AC position		Position used when separate power supply is used.
OFF position		Open-circuits plate and filament voltage supply to tubes, and BT103, BT104.
BAT position		Position used when self-contained battery pack is used.
Function Switch (S105)		
ZERO position		Position used for checking electrical zero indication of meter.
DIODE position		Position used for checking for proper shot noise diode adjustment.
CAL position		Places calibrator circuit in operation.
FI position		Weights signal for field intensity measurements.
QP position		Weights signal for quasi-peak measurements.
PEAK position		Provides dc to detector for slide-back voltage measurements.
Scope (J104)		Receptacle for oscilloscope used for visual monitoring.
AUDIO (J103)		Headphone receptacle for aural monitoring.
EXT METER J106)		Receptacle for external meter connection.
POWER (J108)		Operating power input.
		ON POWER SUPPLY 90780-2
RECORDER CHART DRIVE (J302)		Power source for Esterline-Angus Recorder 90097-2, or equivalent. Used only when external power source frequency is the same frequency as the power input to the recorder.
POWER OUTPUT (J303)		Receptacle for operating potential supply to RI-FI Meter.
GROUND (E301)		External ground.

LEGEND (Cont'd)	FUNCTION (Cont'd)
POWER INPUT (J301)	Receptacle for power input from external source.
F-301	3/8 Ampere active line fuse.
F-302	3/8 Ampere spare fuse.

3. DESCRIPTION OF CALIBRATION CHARTS

3a. Calibration Charts consist of eight vinylite sheets containing simplified operating instructions and a family of calibration curves that are plotted for each individual Radio Interference-Field Intensity Meter.

The first sheet supplies simplified operating instructions, including instructions for the proper use of the curves on the succeeding sheets.

Before making a measurement on a given frequency, it is necessary to adjust the gain of the RI-FI Meter, by means of the CAL control, so that the meter will read 100 when a signal of 100 units is present at the LOOP or ANT input receptacles. The CAL control is adjusted to give a meter reading on the decibel scale obtained from the calibration curves for the particular input device in use. A curve for each of the seven frequency bands is given in charts #1 and #2 for use with the Rod Antenna 90291-2 or either of the Matching Impedance Networks 90305-4, 90305-7,(or 90305-6) connected to the ANT receptacle of the RI-FI Meter NM-20B. Charts #3 and #4 contain similar curves for use with the Loop Antenna 90298-2 connected to the LOOP receptacle, and charts #5 and #6 contain similar curves for use with the Line Probe 90093-4 connected by means of Cable 90048-2 (20'0") to the LOOP receptacle.

The effective bandwidth of the RI-FI Meter for any given frequency in the seven bands can be determined from the curves on charts #7 and #8.

Chart #9 is a correction chart used for determining a true measurement of sine wave signal strength in the presence of high ambient interference of random nature. Two measurements are required--one of the signal plus noise and one of the background noise.

No calibration is furnished for loop operation with Antenna 90185-2 (loop probe) or Antenna 90298-2 (loop antenna) when operated with Cable 90048-2 (20'0").

CAUTION

DO NOT OPERATE NM-20B WITHOUT BIAS BATTERIES, UNDER ANY CONDITION

4. OPERATING INSTRUCTIONS

4a. Introduction:

Instructions for connecting the various input devices and the remote meter are given in Section 3, Installation. In the procedures given here, only a statement of the type of input device required will be given.

The input devices comprise the rod and loop antennas, line probe, RF current probe and matching impedance networks. These units are connected to either the front panel LOOP or ANT receptacles with the corresponding units of measurement shown in the following table:

UNIT OF MEASUREMENT FOR THE INPUT DEVICES

CONNECTION TO ANTENNA RECEPTACLE	
Input Device	Units for Panel-Meter Headings
Rod Antenna	Microvolts-per-meter
Matching Impedance General Purpose	Microvolts
Matching Impedance 50 Ohm	Microvolts
Current Probe	Microvolts across transfer impedance

CONNECTION TO LOOP RECEPTACLE	
Input Device	Units for Panel-Meter Headings
Loop Antennas	Microvolts-per-Meter
Line Probe	Microvolts
Loop Probe	Qualitative indications only

4b. Use of Loop Input Devices:

The loop antennas are used for field intensity and radio interference measurements, that is, for determining the bearing of a signal source and then measuring the strength of the signal.

Step 1. When the signal being measured is properly tuned in, rotate the loop to obtain an aural null.

NOTE

WHEN A SHARP NULL CANNOT BE OBTAINED BECAUSE THE SIGNAL IS VERY STRONG, ADJUST THE ATTENUATOR CONTROL SETTING AS NECESSARY TO REDUCE THE SIGNAL. SHARPEST NULLS ARE OBTAINED WITH THE HIGHEST FEASIBLE ATTENUATOR SETTING. NOTE THAT THE $X10^3$ AND $X10^4$ ATTENUATOR POSITIONS ARE NOT FOR LOOP OPERATION. IN THE PRESENCE OF HIGH ACOUSTICAL NOISE AT THE SURVEY SITE, USE THE METER IN CONJUNCTION WITH HEADPHONES TO OBTAIN THE NULL INDICATION.

Step 2. If desired, the magnetic bearing to the signal source can be

determined by using a pocket compass and the direction indicated by the aural null. Bear in mind that bilateral bearings are obtained with the loop. The ambiguity must be resolved by triangulation.

Step 3. Rotate the loop ninety degrees away from the null point, then make the measurement of the signal. This is required to give maximum signal input to the RI-FI Meter.

The loop probe affords the directional characteristics of a loop antenna. It is connected by the Loop Cable 90048-2 to the LOOP input receptacle and is used to search for sources of radiated energy. Since absolute calibration for the loop probe is not feasible at the frequencies used, the meter indicates aural null when the loop probe is oriented for null.

Measurements made with the loop antennas, particularly at the higher frequencies, may be subject to error when received signals are of mixed polarization. Refer to the Instruction Manual for Large Loop Antenna 91077-2 for additional information on that loop antenna.

4c. Use of Rod Antenna:

Measurements made with the Rod Antenna 90291-2 may be in error, varying with the soil conductivity and the height of the equipment above ground. In the survey report, give a complete description of the antenna height above ground. Include a description of the survey site, the topography, electrical properties of the ground, and the proximity of disturbing structures. Determine that only one power cable is grounded in order to avoid a ground loop.

4d. Signal Measurements

Step 1. Turn power switch to BAT, or to AC if an external ac power source is used.

Step 2. Turn Meter switch to 'A' ADJ.

Step 3. Adjust 'A' ADJ control to bring the meter pointer to the red mark on the meter scale.

Step 4. Turn METER switch to 'B' ADJ.

Step 5. Adjust 'B' ADJ control to bring the meter pointer to the red mark on the meter scale.

Step 6. Turn METER switch to USE.

Step 7. Turn function switch to DIODE. A meter reading of approximately 75 should be obtained, however an indication between 20 to 100 microvolts is acceptable.

NOTE

THE DIODE CURRENT IS ADJUSTED BY MEANS OF THE BACK-OF-PANEL ADJ DIODE CONTROL. ONCE PROPERLY SET, AND "A" AND "B" VOLTAGES ARE CORRECTLY ADJUSTED, IT IS NOT NECESSARY TO RESET ADJ DIODE FREQUENTLY.

Step 8. Turn input control, attenuator control, and function switch to the CAL position.

Step 9. Rotate the BAND selector to select the desired frequency band. Rotate the TUNE control to select the desired frequency.

Step 10. Turn meter switch to A and B adjust. Adjust A and B voltages as required.

Step 11. Refer to the chart corresponding to the input device used and obtain correct value of calibration voltage for standardization at the desired frequency. Adjust CAL control until indicating meter reads the correct calibration voltage on the decibel scale. (Example: For a frequency of 2.4 mc using the Rod Antenna 90291-2, enter Chart #1 from the bottom at 2.4 mc on the Band 4 curve. Follow up to intersect the plotted curve. From the point of intersection, follow to the left to find the calibration setting to be used, in this case 20). Adjust CAL control until meter reads the correct calibration voltage on the decibel scale. (Example: In this case, 20).

Step 12. Turn METER switch to the A and B positions, and adjust the 'A' ADJ and 'B' ADJ controls to bring the meter pointer to the red mark on the meter scale.

NOTE

FOR ACCURATE MEASUREMENTS, IT IS NECESSARY TO CHECK THE ADJUSTMENT OF THE 'A' AND 'B' ADJ CONTROLS PRIOR TO EVERY MEASUREMENT. THIS IS REQUIRED BECAUSE THE B VOLTAGE DOES NOT HOLD SUFFICIENTLY CONSTANT OVER THE PERIOD OF TIME REQUIRED FOR THE USUAL SERIES OF MEASUREMENTS. A VERY SMALL CHANGE IN B VOLTAGE CAN RESULT IN AN ERROR THAT CANNOT BE IGNORED.

Step 13. Turn METER switch to USE. Check adjustment of CAL control as in Step 11.

Step 14. Turn function switch to the desired position.

NOTE

USE THE FI (FIELD INTENSITY) POSITION FOR BOTH FIELD INTENSITY AND RADIO INTERFERENCE MEASUREMENTS. THE QP (QUASI-PEAK) POSITION IS USED IN RADIO INTERFERENCE MEASUREMENTS TO OBTAIN A "WEIGHTED" VALUE. USE THE PEAK POSITION TO MEASURE THE PEAK OF A RADIO INTERFERENCE SIGNAL AS SEEN BY THE SECOND DETECTOR.

Step 15. Turn input control to ANT or LOOP, according to the type of input device used.

Step 16. Tune in desired signal. Tune CW signals for maximum meter reading.

NOTE

BFO SWITCH MUST BE OFF WHILE TUNING FOR MAXIMUM METER READING AND BEFORE NOTING

AND RECORDING METER READINGS SINCE THE METER IS DISABLED WHEN THE BFO SWITCH IS ON. BFO IS USED ONLY FOR IDENTIFICATION OF SIGNALS. THE BFO HAS BEEN ADJUSTED TO GIVE SUITABLE TONE WHEN CW SIGNAL IS TUNED FOR MAXIMUM METER READING. DO NOT ATTEMPT TO TUNE FOR AN AURAL ZERO BEAT.

Step 17. Adjust position of attenuator control until meter reads within meter scale range, preferably in the upper portion of the meter scale.

Step 18. Turn METER switch to the 'A' and 'B' ADJ positions. Make final check of 'A' and 'B' ADJ control settings.

Step 19. Read indicating meter in microvolts. Compute the value of the measured signal as follows: When the Rod Antenna 90291-2 (.5 meter effective height) is used, multiply the meter reading by twice the correction factor for Charts #1 and #2 (normally 1) and multiply this product by the attenuator control setting. (Example: Assume attenuator control setting is X10^2 and meter indication is 10 microvolts. Then, 10 x (2 x 1) x 10^2 = 2000 microvolts-per meter).

When the Small Loop Antenna 90298-2 is used, multiply the meter reading by the correction factor for Charts #3 and #4 (normally 10) and multiply this product by the attenuator control setting. (Example: Assume attenuator control setting is X10^2 and meter indication is 10 microvolts. Then, 10 x 10 x 10^2 = 10,000 microvolts-per-meter).

When Line Probe 90093-4 is used, multiply the meter reading by the correction factor for Charts #5 and #6 (normally 1) and multiply this product by the attenuator control setting. (Example: Assume attenuator control setting is X10 and meter indication is 10^2 microvolts. Then, 10 x 1 x 10^2 = 1000 microvolts).

NOTE

THE OBSERVED RADIO INTERFERENCE IS MEASURED IN MICROVOLTS. THE OBSERVED FIELD INTENSITY MAY BE MEASURED IN EITHER MICROVOLTS-PER-METER OR DECIBELS ABOVE ONE MICROVOLT-PER-METER.

Since the db scale of the indicating meter is calibrated to a base level of one microvolt, field intensity readings in db above one microvolt may be read directly from the db scale of the indicating meter. When the Rod Antenna 90291-2 is used, a factor of 6 db must be added to the observed reading. Add a 20 db factor when the small loop antenna 90185-2 is used. (Example 1: assume rod antenna in use, attenuator control setting is +40 db, and meter indication is 20 db. Then, 20 db + 6 db + 40 db = 66 db. Example 2: Assume small loop antenna in use, attenuator control setting is +40 db, and meter indication is 20 db. Then, 20db+20 db+40 db = 80 db.) An additional factor must be included when the Large Loop Antenna is used.

Step 19. For measurement of the effective peak value of random or impulse interference, the slideback VTVM circuit is used. Turn the function switch to PEAK.

Step 20. Turn the PEAK control completely counterclockwise.

Step 21. Turn the attenuator control through its positions until an indication is obtained in the upper portion of the meter scale, if possible.

Step 22. Adjust the AUDIO control for a convenient headphone signal level. Slowly turn the PEAK control clockwise until the received headphone signal just becomes inaudible. If necessary advance the AUDIO control to a high level at the same time that the PEAK control is turned to facilitate establishment of this point. Do not advance the PEAK control beyond the point of inaudibility, or an erroneous indication will result. Observe the pointer of the indicating meter as the point of inaudibility is approached. If the pointer goes off-scale, advance the attenuator control to the next higher position and return the PEAK control to its fully counterclockwise position. Then repeat the adjustment of PEAK and AUDIO controls to determine the point of inaudibility.

Step 23. Read the indicating meter.

NOTE

THE METER READING IS EQUIVALENT TO A BIAS VOLTAGE (INTRODUCED BY PEAK CONTROL) THAT IS IDENTICAL TO THE PEAK VALUE OF THE INPUT SIGNAL AS SEEN BY THE SECOND DETECTOR.

Compute the effective peak value of the measured signal by applying the attenuator factor and correction factors obtained from calibration charts to the observed meter reading. (Example 1: Assume rod antenna in use, attenuator control setting is X10^2, and meter indication is 10 microvolts. Refer to Charts #1 and #2. Then, 10 x (2 x 1) x 10^2 = 2000 uv/meter. Example 2: Assume small loop antenna in use, attenuator control setting is X10^2, and meter indication is 10 microvolts. Refer to Charts #3 and #4. Then, 10 x 10 x 10^2 = 10,000 uv/meter. Example 3: Assume line probe in use, attenuator control setting is X10^2, and meter indication is 10 microvolts. Refer to Charts #5 and #6. Then, 10 x 1 x 10^2 = 1000 microvolts.)

4e. Sine Wave Signal Measurements in the Presence of High Ambient Interference:

When a sine wave signal is being measured in the presence of high ambient interference of random nature, it is possible to correct for the interference and determine the actual value of the signal as though the random interference were not present. Obtain the value of interference and signal combined and the value of "noise only". The "noise only"

figure may be obtained by turning off the signal, if possible, or detuning slightly. Monitor with the headphones to determine how far to detune. When using the QP function, subtract the value of "noise only" directly from the value of interference and signal combined. When using the FI function, proceed as follows:

Step 1. Standardize the gain of the equipment for the frequency of the incoming signal by going through steps 1 to 12 of paragraph 4d above. Use the appropriate curve from Charts #1 through #6, according to the input device and frequency used.

Step 2. Set the function switch to FI.

Step 3. Note the meter reading of the random interference in the absence of signal. If necessary, detune slightly off signal.

Step 4. Tune in signal and note meter reading of signal and random interference combined.

Step 5. In chart #9, locate the meter reading of "noise plus signal" on horizontal scale of chart. (Example: Assume 55 microvolts).

Step 6. Follow the arc upward until it intersects the horizontal line which represents the "noise only" meter reading. (Example: 35 microvolts).

Step 7. Drop down from the point of intersection to the horizontal scale and read off the corrected meter reading. This is the value of the signal in absence of the random interference. (Example: 43 microvolts).

NOTE

THERE IS NO PROVISION IN THIS INSTRUMENT TO BALANCE OUT THE INTERNAL NOISE. IT WOULD NOT BE PRACTICAL IN THIS CASE. THE ROD ANTENNA REPRESENTS AN INPUT CAPACITY OF ONLY 10 MMFD. THIS IS A SMALL INPUT CAPACITY CONSIDERING THE LOW FREQUENCY RANGE OF THE INSTRUMENT, WHICH THEREFORE TENDS TO HAVE A HIGHER INTERNAL NOISE. CHART #9 CAN BE USED TO DETERMINE THE TRUE INPUT VOLTAGE WHEN THE INTERNAL NOISE IS HIGH.

5. USE AS A SENSITIVE RADIO FREQUENCY MICROVOLTMETER

Radio Interference-Field Intensity Meter NM-20B is a selective, highly sensitive two-terminal voltmeter. By considering the applications carefully, it can be used as listed below:

5a. It can be used as a null instrument in conjunction with RF bridges. Matching Impedance 90305-4 must be used, utilizing extremely short leads, preferably shielded.

5b. It can be used to measure the gain of a radio frequency stage in radio equipment by measuring the signal input to the stage and the signal output of the stage. Matching Impedance 90305-4 must be used and it should be noted that this shunts approximately 10 micro-microfarads across the circuit and may upset the stage under test.

5c. It can be used to check the voltage of any 50-ohm (or higher) impedance transmission line up to one volt, provided the transmission line is properly terminated in the 50-ohm Matching Impedance Network 90305-7. Impedances varying from 65,000 ohms at 150 kc down to approximately 200 ohms at 25 mc can be matched with Matching Impedance Network 90305-4. The impedance of the Line Probe varies from approximately 50 ohms at 25 mc to about 350 ohms at 150 kc.

NOTE

THE LINE PROBE VOLTAGE RATING IS 2500 VOLTS DC AND THE VOLTAGE RATING OF THE MATCHING IMPEDANCE NETWORKS IS 500 VOLTS DC.

5d. It can be used to determine the loss in a coaxial line connected to a signal generator by comparing the signal level at the input and output ends of the line. The appropriate matching impedance network must be used between the line and the RI-FI Meter.

6. SURVEY CONSIDERATIONS

6a. Field Intensity Considerations:

A knowledge of the fundamentals of wave propagation is essential in order to properly conduct field intensity surveys. The study of wave propagation is highly complicated by the large number of variable factors that must be considered and by the interpretation of the results of a series of measurements. This section of the instruction book contains a brief description of some of these factors as they apply to the frequency range covered.

(1) Selecting the Site for Field Intensity Measurements:

It is sometimes necessary to make field intensity measurements at a designated location, and it is then essential to consider the effect of surrounding objects on the received signal strength. Often, however, the measurement location can be selected, and the observer must then know what constitutes a good site for a given set of conditions. True radiation field measurements are made at distances greater than about two wavelengths from the transmitter in order to avoid the influence of the induction field.

In selecting a site for field intensity measurements, the following considerations should be kept in mind: The radio-frequency voltage induced in a receiving antenna is proportional to the intensity of the electro-magnetic field in the space occupied by the antenna. The intensity at this point will depend upon the radiated power; the frequency

of the received signal; the distance from the transmitter; the attenuation over the path between the transmitter and the receiver; reflections and reradiations from nearby conductors such as power lines, wire fences, and steel buildings; absorption by trees; and the effects of hills, gullies, or cliffs.

The ideal site would be an open, flat terrain at a considerable distance (1000 feet or more) from buildings, electric lines, fences, etc. Even buried cables can cause serious effects on the low frequencies since the lower the frequency, the greater the depth of ground penetration. Ideal sites are rare in the more populated sections of the country; therefore, it is good practice to check a proposed location by making measurements of the desired signal at several points in the vicinity. If the same value of field intensity is obtained at each of the points, any one may be considered satisfactory. If it is necessary to use an unsatisfactory site, a series of readings should be recorded at a number of different points in the neighborhood of the selected site, and detailed notes on the site conditions should be appended to the recorded data.

There are no fixed rules to govern the minimum distance between the field intensity measuring equipment and the nearest wire lines or other disturbing objects because possible resonances are unpredictable. Some sites have been found to be satisfactory for low-frequency measurements where the distance was as close as a few hundred feet but a check of the location should always be made if any doubts exist. Another consideration in site selection is the possible presence of local electrical interference sources which may make field intensity measurements difficult.

If measurements are to be made with the equipment mounted in a vehicle, it will be necessary to determine the effect of the vehicle on the received signal. This is done by measuring a signal with the equipment mounted in the vehicle as it is to be used and again with it temporarily located some distance away from the vehicle. If differences are noted, measurements should be taken with the vehicle heading changed 15 or 20 degrees at a time. The differences between the readings taken in the vehicle and those taken outside the vehicle are then plotted in percentages of the outside readings versus heading. A different curve will generally be needed for each operating frequency. A calibration of this type is facilitated by simultaneously using two similar equipments, one equipment set up in the open, and the other mounted in the vehicle and operated 50 to 75 feet away from the former.

(2) Propagation Characteristics for LF, MF and HF:

At the low frequencies, under most conditions, little energy is reflected back to the earth. As the frequency is increased, a greater portion of the sky wave energy is reflected back to the earth.

The ground wave energy, at low frequencies, propagating just above the surface of the earth, suffers little attenuation with distance as compared with ground wave energy at high frequencies.

The relationship of the "sky wave" and the "ground wave" and the factors affecting them are discussed briefly below.

When measuring field intensities in the low, medium and high frequencies, there are two major factors to consider. The more important of these factors is the distance of the measuring site from the transmitting antenna. There is an area wherein the ground wave of the transmitting antenna is too weak to be detected and the sky wave is not present, dependent upon the angle of radiation from transmitting antenna and the angle of reflection of the transmitted signal from the ionosphere. This area, at a distance from the transmitting station, depending upon the transmitting frequency, is called the "skip distance". The extent of this area is dependent to a great degree upon the conditions of the ionosphere at the time of measurement. Therefore, the distance of the recording site from the transmitting antenna and the exact time of measurements are very important.

The next factor in importance is known as the area of fading. The condition is common in the lower portion of the medium frequencies and in the upper portion of the low frequency spectrum. This is an area where the ground wave and sky wave begin to equal each other in intensity. This again, is a problem of wave propagation and the extent of the area in which this phenomena occurs is greatly dependent upon the ionosphere. In this area, large variations in field intensity may be observed within a short period of time. This large variation in field intensity, most commonly referred to as fading, is due to the phase relationship of the sky wave to the ground wave at the receiving site. There are two functions affecting this phase relationship. One is the difference in the distances traversed by the two types of wave fronts, and the other is the shift in phase of the sky wave reflected from the ionosphere.

An example of the varying conditions due to ionospheric changes is described by a condition which is known as night and dawn effect. This effect is due, primarily, to changes in the ionosphere. At, or shortly after sunset, and just before dawn, considerable

changes occur in the ionosphere. It is due to these disturbances that large variations in measured field intensities occur. The higher the frequencies, the greater the effect of these disturbances.

Abnormal propagation conditions cause the measured field intensity values to be higher or lower than would be obtained under normal conditions. Low-frequency signals are, as a rule, much less subject to fading and other irregularities than higher frequency signals. Abnormal conditions do exist, however, and an alert operator should be able to recognize them so that proper notes may be entered in the measurement data.

Abnormal conditions may also be attributed to magnetic or ionospheric storms. During ionospheric storms, the higher frequencies are subject to very erratic changes and a large part of the spectrum above 2000 kilocycles may be entirely "blacked out". The changes on the lower frequencies are not so erratic and violent but occur gradually with marked differences at sunrise and sunset. The higher frequency effects last one or two days; the low frequency effects may last from two days to more than a week. At times, the daytime signal is higher than the nighttime signal. This is just the opposite of normal conditions. It is sometimes of value to check transmissions on higher frequencies for clues as to whether ionospheric conditions are normal. For example, if the standard broadcast band appears to be highly irregular, the low frequency conditions should be subject to suspicion for distances beyond 15 to 20 wave lengths from the transmitter. If abnormal conditions are indicated, arrangements should be made, if possible, to extend the measurement period until propagation conditions return to normal.

(3) Recording of Observed Data:

It is essential that data records be complete so that the results of a survey may be properly interpreted and evaluated. This information should include the date, start and finish time, the test identification, the location (very carefully described as to geographical position and to presence of disturbing objects), the equipment used, the measurement frequency, the calibration, the attenuator setting, the function-switch position, the antenna used, the chart speed, erratic conditions, non-opposite minima, and type of ground connection when using the vertical antenna.

6b. Radio Interference Considerations:

(1) Selecting the Site for General Interference Surveys: Surveys:

An open, flat terrain is preferred to preclude absorption by dense growths of trees, gullies, and steep ridges. Also, the face of a nearby cliff may act as a reflector and produce local variations in the intensity of interference measured.

In order to isolate the radiated field from the induction field of a source of interference, radio interference measurements of a radiating source should be made at distances greater than twice the wave lengths of the radiated energy.

In general, interference surveys made in the vicinity of power lines are subject to inaccurate results because of possible reradiation from the power lines and it is necessary to measure at considerable distance from the power lines.

Every attempt should be made to avoid locating the equipment near closed loops present in iron-framed buildings. If possible, avoid locations in the vicinity of underground pipes, trolley cables, or rail lines.

When the equipment is installed in a vehicle, it should be remembered that the metal body and frame of the vehicle tend to distort the pick-up pattern of the loop antenna. In addition, closed loops formed by vehicle wiring or structural members will affect the field pattern. In some cases, these errors can be determined with the equipment mounted in a designated location. Correction factors so obtained may then be applied to compensate for pick-up pattern distortion.

When a variety of equipment, including radio receivers, is employed at any one site, check for interaction.

Choose at least three sites, not in a line, for radio interference surveys, since triangulation is used to locate the source of interference.

NOTE

SURVEY RESULTS MUST BE EVALUATED ACCORDING TO HOW CLOSE ACTUAL SURVEY SITES APPROACH IDEAL CONDITIONS.

(2) Inteference Survey:

An interference survey of a suspected area should begin with a series of measurements, at the frequencies under investigation, made with the appropriate pick up. It is customary in general surveys to make measurements at five frequencies in each band of the equipment, with sufficient overlap to insure complete coverage of all bands. Should a station or service be found operating on the frequency selected for measurement, move sufficiently away in frequency to avoid the side bands of the station. The survey report should, however, note the frequency and field intensity of signals from the station.

Certain types of interference surveys require scanning an entire band for evidence of peaks or minima. Any such peaks or minima found must be measured and noted in the survey report.

NOTE

WHEN SCANNING A GIVEN FREQUENCY BAND,

USE THE ROD ANTENNA SINCE IT HAS NO DIRECTIONAL CHARACTERISTICS. SET CAL CONTROL FOR A COMFORTABLE BACKGROUND LEVEL, THE AUDIO GAIN CONTROL FOR SUITABLE AUDIO GAIN, AND ATTENUATOR TO X10 POSITION. (THE SIGNAL TO INTERNAL "NOISE" RATIO IS IMPROVED WHEN ATTENUATOR SETTING ON ANY STEP ABOVE X1 IS USED). WHEN A SIGNAL IS HEARD, ADJUST TUNING FOR OPTIMUM RECEPTION. THEN STANDARDIZE THE RI-FI METER AND MAKE THE MEASUREMENT.

During the survey, the received signals should be aurally monitored at a volume level that will enable identification of the received signal or interference.

Three-point fixes on each source of interference enable the geographic location to be determined by triangulation, using magnetic bearings. The next step is to investigate each interference source in turn, moving the RI-FI Meter close to each source of interference and refining the distant fix previously obtained. When the location has been narrowed down to a small area, use the loop probe to determine the offending equipment or power line.

If the interference source is found to be a power line or other current-carrying conductors, substitute the line probe for the loop and use the RI-FI Meter as a two-terminal voltmeter to determine the amount of conducted interference on the line.

WARNING

STANDARD SAFETY PRECAUTIONS SHOULD BE TAKEN WHEN CONNECTING TO POWER LINES OR ANY EQUIPMENT WHICH MAY BE ENERGIZED FROM A SWITCH NOT UNDER THE CONTROL OF THE OPERATOR OF THE NM-20B. ALL CONNECTIONS SHALL BE MADE WITH THE POWER DISCONNECTED FROM THE LINES OR EQUIPMENT.

(3) Rationalizing of Interference Data:

It may be observed that a difference in meter indication may exist between two RI-FI meters in the same location measuring the same noise signal. It is the purpose of the following paragraphs to explain and provide correction factors for this effect.

Variations in the "Q" of tuned circuits, in tube loading, in individual electron tube characteristics and slight tracking differences are normally present in all equipments of this type. For this reason variations in the overall bandpass of equipments are present.

This problem may be resolved by converting the meter reading into microvolts-per-kilocycle bandwidth as a two-terminal voltmeter and into microvolts-per-meter-per-kilocycle bandwidth as a field intensity meter.

If the bandwidth is other than one kilocycle, then the conversion factor (K), by which the meter reading is to be multiplied, will depend upon the type of signal and the bandwidth, as shown below.

(1) In the case of a sine wave signal, the peak, average and effective voltages are <u>independent</u> of bandwidth. The factor, applicable to readings taken in function switch positions FI, QP and PEAK, is therefore:

$$K_{cw} = 1$$

(2) For a noise signal of a predominately random nature, the peak and average voltages are proportional to the square root of the bandwidth. The conversion factor, also applicable to readings taken in function switch positions FI, QP and PEAK, is:

$$K_r = \sqrt{\frac{1\ kc}{\text{Effective random noise bandwidth (kc)}}}$$

(3) When the noise signals are predominately impulsive, the peak value of the voltage is directly proportional to the bandwidth. The conversion factor given below is applicable only to readings taken in the "PEAK" function position:

$$K_i = \frac{1\ kc}{\text{Effective impulse noise bandwidth (kc)}}$$

Average and Quasi Peak readings of impulse signals are also influenced by pulse repetition rate, pulse width, charge time of weighting circuits and the overload factor. For this reason a definite conversion factor cannot be supplied.

When using these conversion factors, the operator should bear in mind that impulse type interference of a high repetition rate assumes the characteristics of random type interference. Under these conditions the operator must carefully evaluate the recorded observations and decide which correction factor is most applicable.

The chart shown below will enable the operator to determine proper detector functions and multiplication factors to use in making various types of measurements.

NOISE PLUS SIGNAL CHART

(1) Type Noise	(2) Type Signal	Detector Function	Direct	RMS*
Random	Sine-Wave	FI QP	X	X
Random	Random	FI QP		X X
Random	Impulse High Repetition	FI QP	X	X

NOTE: Internal Noise is of a random nature.

*RMS = Root Mean Square, e.g. -

$$\sqrt{(\text{signal 1})^2 + (\text{signal 2})^2}$$

The effective bandwidth data provided with Stoddart RI-FI equipment is the same as the "effective random noise bandwidth" mentioned above. When this bandwidth is multiplied by 1.40, the product obtained is the "effective impulse noise bandwidth". For example:

(1) Determine the signal strength in microvolts / meter / kilocycle when the RI-FI equipment, used as a field intensity meter, indicates 2460 microvolts-per-meter. The noise signal is predominately impulsive and the effective bandwidth is four kilocycle s:

$$K_i = \frac{1 \text{ Kc}}{1.40 \times 4 \text{ kc}} = 0.178$$

True impulse sig = K_i x meter ind
= 0.178 x 2460
= 440 uv/M/kc

When the random noise bandwidth is multiplied by 1.30, the product obtained is the 6db bandwidth.

SECTION 5

MAINTENANCE

1. INTRODUCTION

1a. The procedures, illustrations, and tables in this section are for the purpose of assisting maintenance personnel in the repair and adjustment of the NM-20B. This information is presented in the following order:

Localization of Trouble.

Removal of Chassis from Instrument Cases.

Radio Interference-Field Intensity Meter Trouble Shooting and Repair.

Power Supply Trouble Shooting and Repair.

Maintenance Procedures.

2. LOCALIZATION OF TROUBLE

2a. Introduction:

Inspect the entire equipment in an attempt to isolate the faulty unit. Check the interconnection cabling. Determine that the power source is correct and that the operating potential outputs of the power supply are supplied to the Radio Interference-Field Intensity Meter. Compare operation of the RI-FI Meter on both AC and BAT positions of the power switch S106. Check equipment operation with both loop and rod antenna pick-up devices. Determine whether or not output indication can be obtained on the remote meter. Check that panel operating controls are properly employed as described in Section 4.

If one of the pick-up devices or remote indicating units is the source of the trouble, check the continuity of the circuit through the suspected device.

In the event malfunctioning of the equipment is caused by the RI-FI Meter, continue the elimination procedure with the aim of locating the faulty stage.

One major source of improper equipment operating is incorrect calibration and alignment control adjustment. Calibration and alignment tests are given in this section to aid in determining the efficiency of equipment operation (See para. 4a). Complete calibration and alignment procedures are also given to aid in bringing the equipment up to highest sensitivity and accurate calibration. (See para. 6 through 9).

2b. Operational Tests:

When localizing procedures definitely point to a trouble in the Radio Interference-Field Intensity Meter the source can be readily traced to any given stage. The calibrator circuit of V110 constitutes a convenient signal generator for checking operation of the RF, IF, and detector section of the unit. Turn the function switch, attenuator control, and input control to the CAL position. This results in application of filament voltage to the calibrator circuit and consequent injection of a shot noise signal at the meter input. If the RF, IF, detector, and VTVM sections are functioning properly, the receiver output is applied to the panel meter M101 and this indication can be adjusted throughout a wide range of meter indications by means of CAL control (R133).

When the audio stages are the location of trouble, no headphone signal will be heard, but the VTVM circuit will be operative.

3. REMOVAL OF CHASSIS FROM INSTRUMENT CASE

3a. Upon determining that the trouble source is in either the Radio Interference-Field Intensity Meter or Power Supply, the next step is to remove the suspected chassis from its case and trace the trouble to a faulty component.

To open the RI-FI Meter, stand the unit with front panel up. Loosen the ten captive knurled screws on the front panel and lift the chassis out of the case.

To open the power supply, loosen the fourteen front panel screws first. Remove ten screws at the sides of the case and slide the case off the chassis. To gain access to the under-chassis components, lay the chassis on one side so that the front panel is accessible. Remove the fourteen screws at the edges of the front panel. Lift the panel away from the chassis to the extent permitted by the wiring between panel and chassis.

The following procedure must be followed in order to properly seal the RI-FI Meter and Power supply cases when replacing the chassis in the cases. To replace the RI-FI Meter chassis, place the case with open end up and lower the chassis into the case. Hand-tighten the ten knurled captive screws on the front panel. To replace the power supply chassis, stand the power supply on the front-panel guard-handles. Slide the case over the chassis and start the ten screws in the sides of the case. Invert the power supply so that the panel is up. Start the fourteen screws at the edges of the front panel. Tighten the ten screws at the sides of the case. Then tighten the fourteen screws on the front panel.

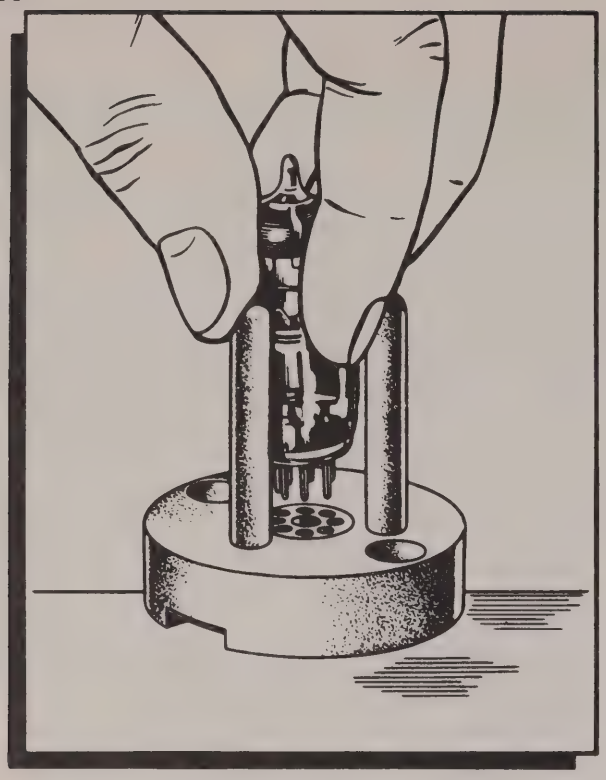


Fig. 5-1 **Miniature** Tube Pin Straightener

4. RADIO INTERFERENCE-FIELD INTENSITY METER TROUBLE SHOOTING AND REPAIR

4a. Repair and Adjustment Data:

(1) Tube Change:

In order to avoid any possible upset of alignment and calibration, avoid interchanging tubes and only replace tubes when a sensitivity test indicates this need. (See para. 4a(3).

Miniature tubes are used throughout this unit. These tubes are held in place by spring-loaded tube shields. To remove a tube, depress and turn the tube shield counterclockwise, then lift. Grasp the tube with two fingers and pull straight out of the socket. Tubes V108, V111, V112, and V113 may be difficult to reach, but are easily pushed out by passing a small metal rod, such as an Allen setscrew wrench, through the center of the tube socket. Straighten bent tube pins using the special tool shown in figure 5-1 before plugging in any tube.

(2) Access to Components:

Access to components within the antenna, mixer, local oscillator, four IF stages, and the detector assemblies requires a special procedure. Three separately shielded stages are used for the RF stages and five stages for the IF and detector stages. One common switch shaft passes through the RF stages and another through the IF stages. The two shafts are operated by the gear train on the chassis subpanel so that the section of the bandswitch in each stage is operated simultaneously from a single front-panel control. In order to remove any one of the RF or IF stages, the switch shaft passing through that row of stages must first be removed. Remove the battery cover and batteries at the rear of the chassis.

NOTE

CLIPS ON THE BRACE ROD RUNNING ACROSS THE CENTER OF THE CHASSIS HOLD A SPECIAL LONG-HANDLED ALLEN SETSCREW WRENCH FOR LOOSENING THE GEAR HUB SETSCREWS. A STANDARD ALLEN SETSCREW WRENCH IS ALSO LOCATED IN A COIL SPRING RETAINER ON THE CHASSIS NEAR V111.

Set the band switch to Band 7 and loosen the Allen capscrew which will now be accessible in the gear at the end of the shaft.

NOTE

THE BAND SWITCH MUST BE LEFT IN THE BAND 7 POSITION. IN THIS POSITION THE FLATS OF THE SWITCH SHAFTS ARE PARALLEL TO THE CHASSIS SURFACE AND THE LOCATING NOTCH IN THE ROTARY PART OF ALL SWITCH SECTIONS IS IN THE FLAT FARTHEST FROM THE CHASSIS SURFACE. THIS NOTCH IS THE KEY TO CORRECT ALIGNMENT, AND ASSURES THAT NO SWITCH SECTION WAFER IS ACCIDENTALLY DISPLACED 180 DEGREES.

Withdraw the switch shaft through the hole in the battery compartment. Any one of the stages in that row can now be removed as follows: When an RF stage is to be removed, unsolder external wiring at the feed-through insulators and at the tube-socket connector on that stage. Remove the two screws that fasten the stage to the chassis. To remove the front and back covers of any RF stage, pry the cover off by means of a screwdriver blade inserted in the rectangular notch at the end of the can.

When an IF stage is to be removed, unsolder external wiring at the feed-through insulators and at the tube-socket connector on that stage. Remove the two nuts on the shield spade bolts and slide the shield of the IF assembly. Remove the two screws that fasten the assembly to the chassis.

When re-installing a stage, be certain that the band-switch section is turned to align with the bandswitch sections in the other stages. Slide the switch shaft through the hole in the battery compartment, through the row of stages, and into the gear hub. Tighten the Allen capscrew on the gear clamp.

CAUTION

DO NOT FORCE THE SWITCH SHAFT SINCE PERMANENT DAMAGE TO SWITCH SECTIONS MAY RESULT.

The BFO can assembly may easily be removed by removing the 6-32 nut and

splitlock washer from each of the two mounting spade lugs. Be certain to unsolder its cable before lifting the can assembly out. Remove the can assembly shield by unscrewing the two screws on top of the can near the 3A5 tube. All components are then visible.

(3) Sensitivity Tests:

Adequate sensitivity is obtained when the following test is satisfied:

Step 1. Set the input control, attenuator control, and the function switch to the CAL position. Set CAL control fully clockwise.

Step 2. Tune the equipment through the entire range of 150 kilocycles to 25 megacycles and observe the meter indication. For the entire frequency range, the meter reading should be 5 microvolts or more.

5. POWER SUPPLY TROUBLE SHOOTING AND REPAIR

5a. Repair and Adjustment Data:

(1) Tube Change:

Any of the tubes in the power supply can usually be replaced without affecting the calibration of the RI-FI Meter.

Tube clamps employed in this unit can be operated with the fingers, or by means of a screwdriver inserted in the slot of the clip.

(2) Voltage Adjustment:

The filament voltage output of the power supply is adjusted by means of the potentiometer R303. The B voltage should measure between 72 and 75 volts dc when the B ADJ control is turned fully clockwise. A jumper at the socket for V302 is used to make the proper connection.

Connect the RI-FI Meter to the power supply to provide the proper load conditions for this adjustment and for use as a measuring device. Turn the 'A' ADJ control fully clockwise. The power line voltage should be adjusted to 105 volts, during the following procedures.

Set the METER switch on the RI-FI Meter to 'A' ADJ. With the 'A' ADJ control set at its mid-point of mechanical rotation, adjust the power supply control R303 so that the meter pointer is on the red mark. Next rotate the 'A' ADJ control from fully counterclockwise to fully clockwise. This should change the position of the meter pointer to a distance to the right of the red mark equal to the distance to the left of the red mark indicated by the pointer when the 'A' ADJ control was in a fully counterclockwise position.

Set the METER switch on the RI-FI Meter to 'B' ADJ. The meter reading on the RI-FI Meter scale should be approximately 1/16 inch past the red mark. If necessary, readjust Meter Series Pot (R155) as explained in para. 7c to obtain the required meter indication.

6. SET-UP OF EQUIPMENT FOR ALIGNMENT AND ADJUSTMENT PROCEDURES

Step 1. Connect the RI-FI Meter and Power Supply by means of the Power Supply Cable 91487-1. Turn the power switch S106 on the RI-FI Meter OFF.

Step 2. Connect Power Supply to a source of 115 or 230-volt ac, preferably 60 cps, by means of AC Power Cable 91258-1. Ground the clip if the three-to-two pin adaptor is used.

Step 3. Connect Line Probe 90093-4 to the RI-FI Meter LOOP receptacle.

Step 4. Connect General Purpose Matching Impedance 90305-4 to the RI-FI Meter ANT receptacle J102 and connect the signal generator output cable to the matching impedance network.

Step 5. Plug headphones into the AUDIO output receptacle.

7. PRELIMINARY CHECKS PRIOR TO ACTUAL ALIGNMENT

7a. Before power is turned on check the mechanical zero setting of pointer in indicating meter M101. This may be set by the screwdriver adjustment on the face of the meter.

7b. Operate the RI-FI Meter power switch S106 to AC. Check voltages at the following points to insure that these are not shorts or grounds:

(1) B+ voltage. Approximately 75 volts.

(2) Filament supply voltage. Approximately 1.1 volts (positive).

7c. Adjusting the Meter Series Pot. (R155).

(1) Set METER switch (S107) to 'A' ADJ.

a. Rotate 'A' ADJ (R145) to position meter needle on vertical red line.

(2) Set METER switch (S107) to 'B' ADJ.

a. Rotate 'B' ADJ (R146) fully clockwise.

b. Adjust the meter Series pot. (R155) to position meter needle approximately 1/16 inch past the red mark.

8. ALIGNMENT AND ADJUSTMENT PROCEDURES

NOTE

ATTENUATOR TRIMMERS IN THE IF ATTENUATOR ARE ACCESSIBLE THROUGH HOLES IN THE BACK OF THE ATTENUATOR SHIELD CAN. TRIMMERS IN THE RF CIRCUITS ARE ACCESSIBLE THROUGH HOLES IN THE TOP AND ONE SIDE OF THE ANTENNA, OSCILLATOR, AND MIXER CANS. BFO TRIMMERS ARE ACCESSIBLE THROUGH HOLES LOCATED IN THE BOTTOM OF THE CHASSIS, WHEN THE FRONT PANEL IS FACING TOWARD THE RIGHT. THE ARABIC NUMBER APPEARING NEAR ANY GIVEN HOLE INDICATES THE PARTICULAR FREQUENCY BAND INVOLVED.

NOTE

IN THE ALIGNMENT AND ADJUSTMENT PROCEDURES, THE FOLLOWING EQUIPMENT OR EQUIVALENTS ARE REQUIRED:

TWO SIGNAL GENERATORS - GENERAL

RADIO MODEL 605B.
OSCILLOSCOPE - NAVY MODEL OBL.
AUDIO OSCILLATOR - NAVY MODEL LAJ.

8a. Adjustment of the ADJ Diode Control R 142:

Step 1. SET-UP OF OPERATING CONTROLS:

Function Switch (S105)	DIODE
'A' and 'B' ADJ	For Meter indication at red mark.
BFO (S112)	OFF
All other controls	Any

Step 2. Adjust the screwdriver control ADJ DIODE (R142) for a meter indication of approximately 75 microvolts. However, an indication between 20 and 100 microvolts is acceptable.

8b. Preliminary Meter Tracking Adjustments:

(1) Adjustment of Electrical Zero:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	Any
Tuning Dial Freq'cy	Any
Attenuator Control	Any
Band Selector	Any
Power Switch (S106)	AC
Function Switch	Zero
'A' and 'B' ADJ	For meter indication at red mark.
BFO (S112)	OFF

Step 2. Zero the indicating meter M101 by adjustment of METER ZERO (R152) located on the chassis directly behind the tuning capacitor.

(2) Adjustment of FI and QP Controls:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	CAL
Tuning Dial Freq'cy	Any
Attenuator Control	$X10^3$
Band Selector	Any
Power Switch (S106)	AC
Function Switch(S105)	As called for
'A' and 'B' ADJ	For meter indication at red mark.
BFO (S112)	OFF

Step 2. With the function switch in FI position, adjust FI control (R139) located behind the tuning capacitor to provide approximately 1% deflection of meter M101 (1/16").

Step 3. With the function switch in QP position, adjust QP control (R140) located behind the tuning capacitor to provide approximately 1% deflection of meter M101 (1/16").

(3) Preliminary Adjustment of the ADJ 100 Control:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	Any
Tuning Dial Frequency	Any
Attenuator Control	Any
Band Selector	Any
Power Switch (S106)	AC
Function Switch (S105)	PEAK
'A' and 'B' ADJ	For meter indication at red mark.
BFO (S112)	

Step 2. Using a 20,000 ohms-per-volt meter, connect the positive lead to the chassis and the negative lead to the arm of the PEAK control (R132) on the front panel. This connection can be conveniently made at the rear wafer of the function switch S105. Select a voltmeter range to conveniently measure 3.5 volts dc and adjust R132 for a reading of 3.5 volts.

Step 3. Set ADJ 100 control (R147), located at the top rear of the left side, so that M101 reads exactly full scale.

Step 4. This adjustment should be followed by a check, and readjustment if necessary, of the two bucking voltage controls. See Adjustment of FI and QP controls, paragraph 8b (2) above.

8c. IF Alignment:

(1) Alignment of IF Stages:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	Any
Tuning Dial Freq'cy	Any
Attenuator Control	X1
Band Selector	Band 1 for 455 KC, Band 2 for 1600 KC.
Power Switch (S106)	AC
Function Switch (S105)	FI
'A' and 'B' ADJ	For meter indication at red mark.
CAL (R133)	Maximum counter-clockwise
BFO (S112)	OFF

Step 2. Connect the signal generator to the middle section of the tuning capacitor C120 with a 0.1 mfd capacitor in series with the ungrounded lead. This is the input to the mixer V102.

Step 3. Set the band selector to Band 1 and the signal generator controls to supply an unmodulated 455 KC signal. Adjust its output for half-scale indication on meter M101.

Step 4. Adjust all 455 KC trimmers (total of 9) available at the tops of the IF stages Z104 through Z108 for maximum deflection of M101. Reduce the signal generator output as required to keep the meter reading within scale.

Step 5. Set the band selector to Band 2 and adjust the signal generator controls for an output frequency of 1600 kc.

Step 6. Adjust all 1600 KC trimmers (total of 9) on the IF stages for maximum deflection of M101. Reduce the signal generator output as required to keep the meter reading within scale.

(2) Adjustment of the IF Attenuator:

NOTE

IF ALIGNMENT PROCEDURE FOR THE FIRST IF (Z104) MUST BE ACCOMPLISHED BEFORE THE IF ATTENUATOR IS ADJUSTED.

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	Any
Tuning Dial Frequency	Any
Attenuator Control	X1
Band Selector	Band 2
Power Switch (S106)	AC
Function Switch (S105)	FI
'A' and 'B' ADJ	For meter indication at red mark.
CAL (R133)	Maximum counterclockwise
BFO (S112)	OFF

Step 2. Connect the signal generator to the middle section of the tuning capacitor C120 with a 0.1 mfd capacitor in series with the ungrounded lead. This is the input to the mixer V102.

Step 3. Set the band selector to Band 2 and the signal generator controls to supply an unmodulated 1600 KC signal. Adjust the signal generator output for a 10 microvolt deflection of M101.

Step 4. Set the attenuator control to the X10 position. Increase the signal generator output ten times. Vary ATTN 10 capacitor (C109) and at the same time maintain tuning with TRIM 10 capacitor (C111) until M101 again reads 10.

Step 5. Set the attenuator control to the X10^2 position. Increase the signal generator output ten times. Vary ATTN 100 capacitor (C110) and at the same time maintain tuning with TRIM 100 capacitor (C113) until M101 again reads 10.

8d. BFO Alignment:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	Any
Tuning Dial Freq'cy	Any
Attenuator Control	X1
Band Selector	Band 2
Power Switch (S106)	AC
Function Switch (S105)	FI
'A' and 'B' ADJ	For meter indication at red mark.
CAL (R133)	Maximum Clockwise
METER Switch	'A' ADJ
BFO Switch (S112)	OFF

Step 2. Carefully tune in a broadcast station on Band 2 (.320-.750mc) with the BFO turned OFF. Adjust the CAL control and the attenuator setting for a meter reading in the upper half of the scale, using the FI function.

Step 3. Turn BFO on and adjust the 1600 kc BFO trimmer in the can assembly. Use an insulated screwdriver or tuning tool and after tuning through an exact zero beat, adjust for an aural note between approximately 800 and 1000 cps. Adjust the AUDIO control to a comfortable level.

Step 4. Carefully tune in a broadcast station on Band 3(.750-1.75mc) with the BFO turned OFF. Adjust the CAL control and attenuator setting for a meter reading in the upper half of the scale, using the FI function.

Step 5. Turn the BFO on and adjust the 455 kc BFO trimmer in the can assembly. Use an insulated screwdriver or tuning tool and after tuning through an exact zero beat, adjust for an aural note between approximately 800 and 1000 cps. Adjust the AUDIO control to a comfortable level.

8e. Final Meter Tracking Adjustments:

(1) Final Adjustment of the ADJ 10 and ADJ 100 Controls:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	Any
Tuning Dial Frequency	Any
Attenuator Control	X10^2
Band Selector	Band 2
Power Switch (S106)	AC
Function Switch (S105)	FI
'A' and 'B' ADJ	For Meter indication at red mark.
CAL (R133)	As required
BFO (S112)	OFF

Step 2. Connect the signal generator to the middle section of the tuning capacitor C120 with a 0.1 mfd capacitor in series with the ungrounded lead. This is the input to the mixer V102.

Step 3. Set CAL control approximately two-thirds clockwise. Set the band selector to Band 2 and the signal generator controls to supply an unmodulated 1600 KC signal. Set signal generator for 1000 microvolts and adjust generator frequency for maximum deflection of M101. Set CAL control for a meter reading of one microvolt.

Step 4. Increase the signal generator output exactly 100 times. Adjust ADJ 100 control (R147) to obtain a meter reading of 100.

Step 5. Reduce the signal generator output exactly 10 times and adjust ADJ 10 control (R110) until a meter reading of 10 is obtained.

Step 6. Reduce the signal generator output exactly 10 times. Readjust CAL control (R133) to obtain a meter reading of one.

Step 7. Repeat Steps 3 through 6 as required to obtain exact meter tracking.

(2) Adjustment of the QP and PEAK Full Scale Controls:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	Any
Tuning Dial Frequency	Any
Attenuator Control	X10^2
Band Selector	Band 2
Power Switch (S106)	AC
Function Switch (S105)	As called for
'A' and 'B' ADJ	For meter indication at red mark.

CAL (R133)	As required
BFO (S112)	OFF

Step 2. Connect the signal generator to the middle section of the tuning capacitor C120 with a 0.1 mfd capacitor in series with the ungrounded lead. This is the input to the mixer V102.

Step 3. Set the band selector to Band 2 and the signal generator controls to supply an unmodulated 1600 kc signal. Set the function switch to the FI position. Set generator output for 1000 microvolts and adjust generator frequency for maximum deflection of M101.

Step 4. Adjust CAL control for a meter reading of one microvolt.

Step 5. Set the function switch to the QP position. Adjust QP control(R140) to obtain a meter reading of one microvolt.

Step 6. Increase generator output 100 times and adjust PFS control (R129) for a meter reading of 100 microvolts.

Step 7. Decrease generator output 100 times and check for a meter reading of one microvolt. Set function switch to QP position and check that a meter reading of one microvolt is obtained. Repeat Steps 5 and 6 if necessary.

(3) Adjustment of the PEAK ADJ Control:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	Any
Tuning Dial Frequency	Any
Attenuator Control	$X10^2$
Band Selector	Band 2
Power Switch (S106)	AC
Function Switch (S105)	As called for
'A' and 'B' ADJ	For meter indication at red mark.
CAL (R133)	Maximum clockwise
AUDIO (R121)	Maximum clockwise
BFO (S112)	OFF

Step 2. Connect the signal generator to the middle section of the tuning capacitor C120 with a 0.1 mfd capacitor in series with the ungrounded lead. This is the input to the mixer V102.

Step 3. Set the band selector to Band 2 and the signal generator controls to supply a 1600 kc signal, 30% modulated at 1000 cycles. Set the function switch to the FI position. Adjust the signal generator output for a meter reading of ten.

Step 4. Set the function switch to the PEAK position. Simultaneously adjust PEAK ADJ control (R135) on the chassis and PEAK control (R132) on the front panel until an aural threshold occurs with the meter indicating 13 microvolts.

8f. RF Alignment of Bands 1 and 7:

NOTE

A 40-OHM SERIES RESITOR MUST BE USED ON THE SIGNAL GENERATOR (GENERAL RADIO MODEL 605B) ON ALL ATTENUATOR STEPS EXCEPT X10,000

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	ANT
Tuning Dial Frequency	As called for
Attenuator Control	$X10^2$ or less
Band Selector	As called for
Power Switch (S106)	AC
Function Switch (S105)	FI
'A' and 'B' ADJ	For meter indication at red mark.
CAL Control (R133)	Maximum clockwise
BFO (S112)	OFF

Step 2. Use the signal generator with output cable terminating in a coaxial connector type UG-21/U. Connect Matching Impedance 90305-6 (50 ohm) into the ANT receptacle of the RI-F I Meter and connect the signal generator to the matching impedance.

Step 3. Set the band selector to Band 1 and the tuning dial frequency to .320 mc. Set the signal generator controls to supply an unmodulated .320 mc signal with sufficient output to give a usable indication on M101. Adjust Band 1 trimmer capacitors in the oscillator, RF, and antenna stages for maximum meter indication on M101.

NOTE

ON BANDS 1 THROUGH 6 THE LOCAL OSCILLATOR FREQUENCY IS HIGHER THAN THE SIGNAL FREQUENCY BY THE VALUE OF THE IF FREQUENCY FOR EACH BAND. ON BAND 7 THE OSCILLATOR FREQUENCY IS LOWER THAN THE SIGNAL FREQUENCY BY THE VALUE OF THE IF FREQUENCY. ON BAND 7, WHERE THE DIFFERENCE BETWEEN OSCILLATOR FREQUENCY AND SIGNAL FREQUENCY IS RELATIVELY SMALL, IT IS POSSIBLE TO TUNE TO THE HIGH SIDE OF THE SIGNAL FREQUENCY BY AN AMOUNT EQUAL TO THE IF FREQUENCY, AND HAVE APPARENTLY NORMAL OPERATION. HOWEVER, UNDER THESE CONDITIONS THE OSCILLATOR WILL NOT TRACK WITH THE RF CIRCUITS AND THE CALIBRATION AND SENSITIVITY WILL BE NORMAL ONLY AT THE POINT OF THIS ADJUSTMENT. DURING ALIGNMENT, THE CORRECT OPERATION POINT IS THE SECOND OF TWO MAXIMA WHICH WILL BE PASSED THROUGH IF THE TRANSFORMER SLUG IS SCREWED FROM AN EXTREME "OUT" POSITION TO AN "IN" POSITION. THIS, OF COURSE, MAY NOT BE THE EXACT FINAL POSITION AFTER ALL ADJUSTMENTS ARE MADE.

Step 4. Adjust the tuning dial frequency to 0.150 mc and adjust the signal generator to 0.150 mc. Adjust Band 1 transformer slugs in the oscillator, RF, and antenna cans for maximum meter indication on M101.

Step 5. Repeat Steps 3 and 4 until adjustment of the trimmer capacitors result in no appreciable movement of the meter pointer.

Step 6. Band 7 is adjusted in the same manner indicated in Steps 3, 4 and

5, above, except for appropriate signal generator and coupling device. The alignment frequencies are at the high end 25 mc and at the low end 15 mc.

8g. INPUT Circuit Adjustments:

NOTE

THE RF ALIGNMENT PROCEDURE OF BAND 7 MUST BE ACCOMPLISHED BEFORE THE INPUT CIRCUIT IS ADJUSTED. (See Paragraph 8f)

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	As required.
Tuning Dial Freq'cy	As required.
Attenuator Control	X10[2]
Band Selector	As required.
Power Switch (S106)	AC
Function Switch (S105)	FI
'A' and 'B' ADJ	For meter indication at red mark.
CAL Control (R133)	Maximum clockwise.
BFO (S112)	OFF

Step 2. Connect the small loop antenna to the LOOP receptacle(J101). Use of the right-angle adapter connector 10165 is optional. Connect a two or three foot length of insulated wire across the output terminals of the signal generator to form a transmitting loop. This is for the purpose of introducing a signal through the loop antenna, and the signal generator termination is of no importance. Arrange the signal generator loop and the loop antenna for a spacing of one foot or more.

Step 3. Set the input control to the LOOP position, the band selector to Band 1, and the tuning dial frequency to 320 kc. Set the signal generator controls to supply a 320 kc modulated or unmodulated signal of sufficient level to give a convenient reading on M101. Tune the RI-FI Meter for maximum meter indication and adjust the signal generator output to keep the meter indication approximately mid-scale. Adjust the dummy antenna (C108) for a maximum reading on M101. This adjustable capacitor is mounted on the same bracket as the dummy loop coil, on the underside of the chassis, near the input switch. This procedure sets the dummy antenna to approximately the correct setting for Band 7 alignment.

Step 4. Use signal generator with output cable terminating in a coaxial connector type UG-21/U. Connect Matching Impedance 90305-6, 50 ohms, into the ANT receptacle and connect the signal generator cable to the matching impedance.

Step 5. Set the input control to the ANT position, the band selector to Band 7, and the tuning dial frequency to 15 mc. Set the signal generator controls to supply an unmodulated 15-megacycle signal of sufficient level to give a convenient reading on M101. Tune the RI-FI Meter to the signal generator and adjust the signal generator output to keep the meter indication approximately mid-scale. Adjust Band 7 transformer slug in the antenna stage can Z101 for maximum meter indication.

Step 6. Connect signal generator for loop operation as in Step 2. Set the input control to the LOOP position, the band selector to Band 7 and the tuning dial frequency to 15 mc. Set the signal generator controls to supply a 15 mc modulated or unmodulated signal of sufficient level to give a convenient reading on M101. Tune the RI-FI Meter for maximum meter indication and adjust the signal generator output to keep the meter indication approximately mid-scale. Adjust the dummy antenna (C108) for maximum meter indication.

Step 7. Continuing with loop operation as in Step 6 but on a frequency of 25 mc, adjust Band 7 trimmer capacitor (C127) in the antenna stage can Z101 for maximum meter indication.

Step 8. Connect the equipment for antenna operation as in Steps 4 and 5, on a frequency of 25 mc. Adjust the loop trimmer capacitor (C235) for maximum meter indication. This trimmer is located on switch S101.

Step 9. Check the adjustment of Band 7 trimmer capacitor and slug in the antenna stage can Z101 on both loop and antenna operation. If there is an appreciable increase in meter indication carefully repeat Steps 4, 5, 6, 7 and 8, above.

Step 10. Realign Band 1 antenna trimmer and slug.

8h. RF Alignment of Bands 2 through 6:

Step 1. RF alignment of Bands 2 through 6 is adjusted in the manner indicated in Steps 3, 4 and 5, paragraph 8f, except for use of the appropriate signal generator and coupling device. The alignment frequencies are listed below:

Band	High End	Low End
2	.750 mc	.320 mc
3	1.750 mc	.750 mc
4	3.800 mc	1.750 mc
5	8.000 mc	3.800 mc
6	15.000 mc	8.000 mc

8i. Adjustment of the RF Attenuator:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	ANT
Tuning Dial Freq'cy	3.8 mc
Attenuator Control	As called for
Band Selector	Band 5
Power Switch (S106)	AC
Function Switch (S105)	FI
'A' and 'B' ADJ	For meter indication at red mark.
CAL Control (R133)	As called for
BFO (S112)	OFF

Step 2. Use signal generator with

output cable terminating in a coaxial connector type UG-21/U. Connect matching impedance 90305-6, 50 ohms, into the ANT receptacle and connect the signal generator cable to the matching impedance.

Step 3. Set the signal generator controls to supply an unmodulated 3.8 mc signal and adjust its output to 1,000 microvolts.

Step 4. Carefully tune in the signal for maximum meter indication. Operate the attenuator control to $X10^2$. Adjust the CAL control for a meter reading of exactly 10 microvolts.

Step 5. Increase the signal generator output to 10,000 microvolts and operate the attenuator control to $X10^3$. Adjust the attenuator capacitor (C102) while maintaining tuning by means of the trimmer capacitor (C101) until the meter again reads 10 microvolts.

Step 6. Increase the signal generator output to 100,000 microvolts and operate the attenuator control to $X10^4$. Adjust the attenuator capacitor (C104) while maintaining tuning by means of the trimmer capacitor (C106) until the meter again reads 10 microvolts.

9. CORRECTING CALIBRATION CHARTS AFTER ALIGNMENT

9a. General:

Data plotted on all charts have been plotted for the individual equipment as shipped. Upon completing the maintenance procedures described in paragraph 8, it is necessary to obtain new data and plot these charts accordingly. The original plot can be erased and new curves drawn in with pencil or a draftsmans' pen.

After the Radio Interference-Field Intensity Meter has been aligned in accordance with instructions in para. 8, obtain data for Chart Set at each of the calibration frequencies.

The calibrating procedure is the same for Charts #1 through #6, except for the input device used.

(1) Voltage calibration for the rod antenna is accomplished by connecting the appropriate signal generator, properly terminated, to the ANT receptacle of the RI-FI Meter.

(2) Voltage calibration for the line probe is accomplished by connecting the appropriate signal generator to the probe and connecting the probe to the LOOP receptacle on the RI-FI Meter by means of Loop Cable 90048-2.

(3) Calibration of the small loop antenna against field intensity measurements made with the rod antenna would be subject to considerable error because of variations due to location, soil, moisture, differences in polarization, and orientation of antennas. Recalibration of the loop antenna should be unnecessary unless data taken on rod antenna recalibration differ greatly from the original calibration.

When required, calibration for loop antenna must be accomplished in a shielded room equipped with a standard transmission line. The standard transmission line must be so installed and terminated as to provide a standard field intensity over the .150 to 25 mc frequency range of the RI-FI Meter. The calibration is conducted with the loop antenna connected to the LOOP receptacle and the RI-FI Meter operated in a known field intensity within the shielded room.

9b. Calibrating Procedure:

Step 1. SET-UP OF OPERATING CONTROLS:

Input Control	As called for
Tuning Dial Freq'cy	As called for
Attenuator Control	X10
Band Selector	As called for
Power Switch (S106)	AC
Function Switch (S105)	As called for
'A' and 'B' ADJ	For Meter indication at red mark.
CAL Control (R133)	As called for
BFO (S112)	OFF

NOTE

THE ABSOLUTE VALUE OF CALIBRATION DEPENDS UPON THE ACCURACY OF THE CALIBRATING SOURCE. BE CERTAIN THAT THE SIGNAL GENERATOR IS PROPERLY TERMINATED, PARTICULARLY AT FREQUENCIES ABOVE TEN MEGACYCLES.

Step 2. Connect the appropriate signal generator to the RI-FI Meter (see paragraph 9a).

Step 3. Check the meter zero and diode current by setting the function switch to these positions and observe that the meter does read at zero and within the diode current range. Check the A and B voltage adjustments.

Step 4. Set the signal generator at the desired frequency and adjust the signal generator output to provide 1000 microvolts at the input of the RI-FI Meter. Observe any correction factor necessary because of termination reqirements.

Step 5. Set the input control to ANT or LOOP, according to the input device in use. Set the function switch to the FI position.

Step 6. Set the band selector to the desired band and carefully tune to the test signal.

Step 7. Adjust the CAL control to give a meter reading of 100. Quickly check and adjust the A and B voltages as necessary. For greatest accuracy, the B voltage must be adjusted again after the signal has been introduced, especially for signals reading in the upper portion of the scale. This will be most evident with operation on fresh B batteries.

Step 8. Set the attenuator control to the X1 position.

Step 9. Set the input control to CAL and the function switch to CAL.

Step 10. Record the meter reading on the db scale of M101 as the calibrating figure to be plotted on the appropriate frequency band of Charts #1 through #6, according to the input device used.

NOTE

FOR GREATEST ACCURACY, CORRECT THE B VOLTAGE ADJUSTMENT JUST BEFORE READING AND RECORDING THE METER READING.

9c. Chart #7 and #8, Effective Bandwidth:

Two signal generators are used in conjunction with an audio oscillator and an oscilloscope to obtain data for determining effective bandwidth at discrete frequencies. One signal generator is used as a "variable" generator and the other as a "marker" generator.

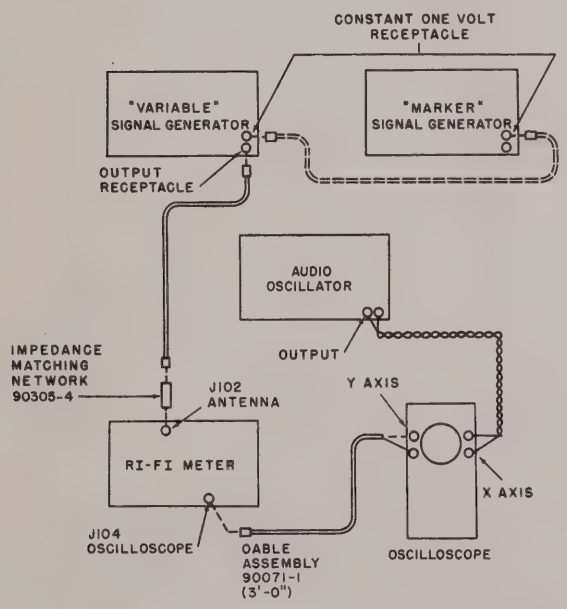


Fig. 5-2 Test Set-Up to Determine Data for Charts #7 and #8

Step 1. Connect Matching Impedance (General Purpose) 90305-4 to the ANT receptacle on the Radio Interference-Field Intensity Meter. Connect the "variable" signal generator output to this network using the signal generator output cable terminating in a coaxial connector type UG-21/U. Connect Cable Assembly 90071-1 (3'0") to SCOPE receptacle on the RI-FI Meter and to the vertical input terminals of the oscilloscope. Using the required length of twisted pair conductor, connect the output of the audio oscillator to the horizontal input terminals of the oscilloscope.

Step 2. SET-UP OF OPERATING CONTROLS:

Input Control	ANT
Tuning Dial Freq'cy	As called for
Attenuator Control	X10
Band Selector	As called for
Power Switch (S106)	AC
Function Switch (S105)	FI
'A' and 'B' ADJ	For meter indication at red mark.
CAL Control (R133)	As called for
BFO (S112)	OFF

Step 3. Set the "variable" signal generator controls to supply an unmodulated .150 mc signal and adjust its output to 100 microvolts.

Step 4. Set the band selector to Band 1 and the tuning dial to 150 kc. Carefully adjust the tuning dial for a maximum meter indication.

Step 5. Adjust the CAL control until the meter indicates exactly 10 microvolts or 20 db.

Step 6. Using the coaxial patch cord, connect the CONSTANT 1 VOLT receptacle of the "marker" signal generator to the CONSTANT 1 VOLT receptacle of the "variable" signal generator.

Step 7. Adjust the frequency of the "marker" signal generator to the frequency of the "variable" signal generator. This is accomplished by observing the output reference meters on the signal generators as the frequency of the "marker" generator approaches that of the "variable" generator. As zero beat is approached, the output reference meter pointers will begin oscillating slower and with increasingly wider swings. At exactly zero beat, both meter pointers will stop oscillating.

Step 8. Disconnect the coaxial patch cord from the CONSTANT 1 VOLT receptacle of the "variable" signal generator.

Step 9. Adjust the frequency of the "variable" signal generator below resonance until the RI-FI Meter indication drops from 20 db to 16 db, or "4 db down", keeping the output of the signal generator constant at 100 microvolts.

Step 10. Re-connect the coaxial patch cord to the CONSTANT 1 VOLT receptacle on the "variable" signal generator.

Step 11. Observe the Lissajous figure on the oscilloscope formed by the combination of RI-FI Meter and audio oscillator output. Vary the audio oscillator output for a 1:1 Lissajous figure on the oscilloscope. Read the frequency difference between the two signal generators as indicated by the

audio oscillator dial setting. Record this frequency obtained on the low side of resonance.

Step 12. Repeat steps 8 through 11 on the high side of resonance. Record the difference frequency so obtained.

Step 13. Add and record the sum of the difference frequencies obtained on the high and low sides of resonance at 150 kc. This sum is the effective bandwidth at that frequency, and is the value plotted on Chart #7 and #8.

Step 14. Follow the procedure in Steps 3 through 13 for the balance of the frequencies tabulated as follows:

Band 1	Band 2	Band 3	Band 4	Band 5
	.320	.750	2.800	6.000
.190	.430	1.000		
.230	.540	1.250		
.270	.640	1.500		
.320	.750	1.750		

NOTE

NO MEASUREMENTS ARE TAKEN ON BANDS 6 AND 7, SINCE THESE BANDS HAVE THE SAME BANDWIDTH AS BAND 5.

Step 15. Plot the points on the effective bandwidth curves of Chart #7 and #8, using the data recorded in step 13. Draw a smooth curve through the plotted points. Only one point in the center of the band is calibrated for Bands 4 through 7 because the curve for these bands is a straight line.

TABLE 5-1 ELECTRON TUBE OPERATING VOLTAGES

SYMBOL	TUBE	FUNCTION	PLATE VOLTS	SCREEN VOLTS	GRID VOLTS	FILAMENT VOLTS
V101	1T4	RF Amplifier	75	47.5	-0.2	1.1
V102	1R5	Mixer	75	** 40-50	-0.4	1.1
V103	1T4	1st IF Amplifier	75	63	0	1.1
V104	1T4	2nd IF Amplifier	75	62	-0.1	1.1
V105	1T4	3rd IF Amplifier	75	60	***	1.1
V106	3V4	4th IF Amplifier	75	72	-3.0	1.1
V107	3A5	2nd Detector	0	--	0	1.1
V108	1U5	1st Audio	30	15	0	1.1
V109	3A5	Local Oscillator	75	--	0	1.1
V110*	3A5	Calibrator	75	--	0	1.1
V111	3V4	VTVM	50	50	-0.1	1.1
V112	3V4	VTVM	50	50	-0.6	1.1
V113	3V4	Audio Output	70	75	****	1.1
V114	3A5	Beat Frequency Oscillator	15	--	-0.1	1.1
V301	2A20	Regulator	31 volts ac measured from pin 2 to pin 7			
V302	0A3/VR75	Regulator	75 volts from pin 5 to ground (nominal)			

* Function switch at DIODE position.
** Varies between Band 1 and Band 7.

*** -0.1 to -9.0
**** -0.25v with 20,000 ohms per volt meter or 4.5v with VTVM

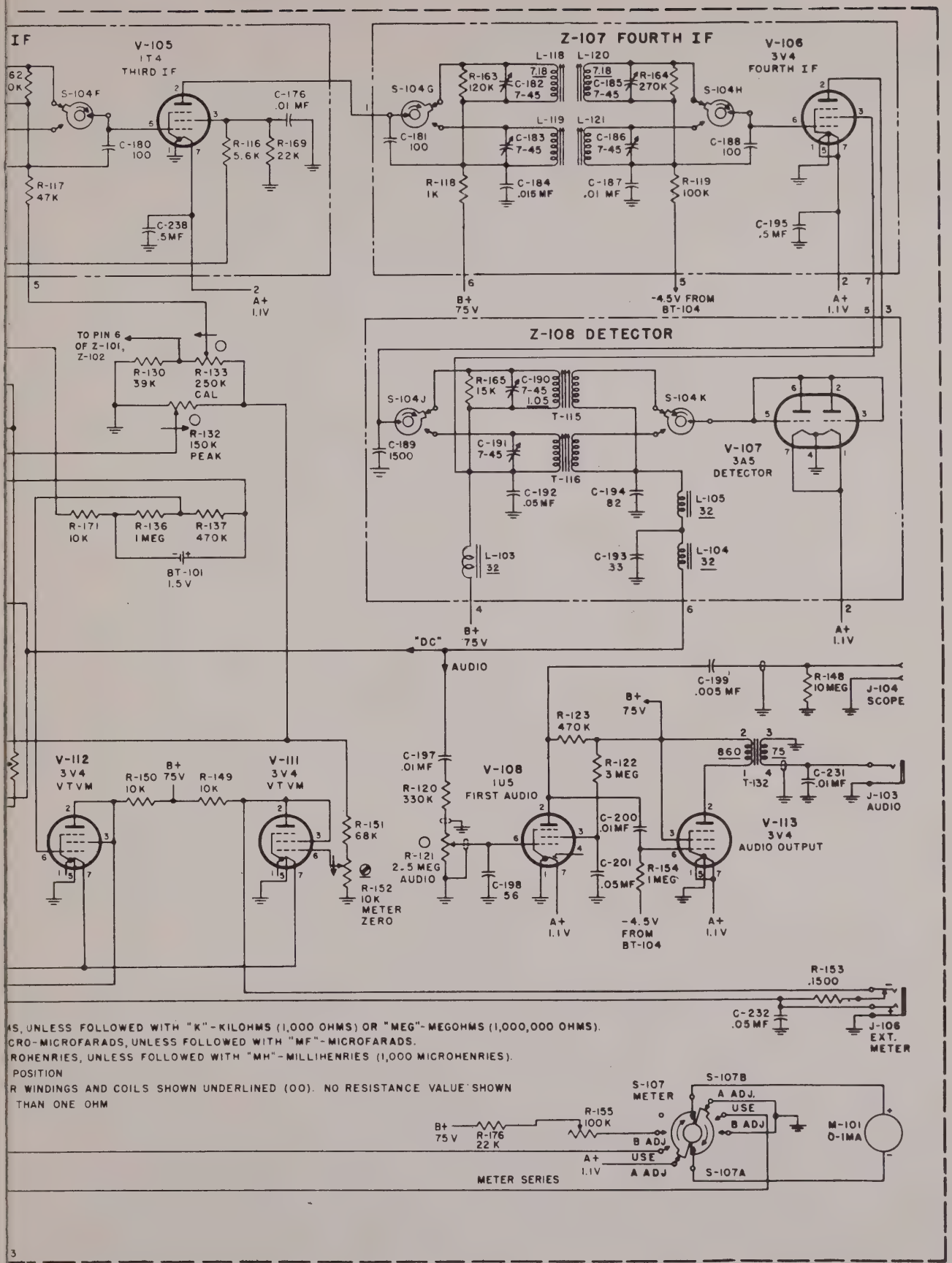


FIG. 5-3 NM-20B RADIO INTERFERENCE-FIELD INTENSITY METER, SCHEMATIC DIAGRAM

(REPRINTED OCT. 14, 1963)

audio oscillator dial setting. Record this frequency obtained on the low side of resonance.

Step 12. Repeat steps 8 through 11 on the high side of resonance. Record the difference frequency so obtained.

Step 13. Add and record the sum of the difference frequencies obtained on the high and low sides of resonance at 150 kc. This sum is the effective bandwidth at that frequency, and is the value plotted on Chart #7 and #8.

Step 14. Follow the procedure in Steps 3 through 13 for the balance of the frequencies tabulated as follows:

Band 1	Band 2	Band 3	Band 4	Band 5
	.320	.750	2.800	6.000
.190	.430	1.000		
.230	.540	1.250		
.270	.640	1.500		
.320	.750	1.750		

NOTE

NO MEASUREMENTS ARE TAKEN ON BANDS 6 AND 7, SINCE THESE BANDS HAVE THE SAME BANDWIDTH AS BAND 5.

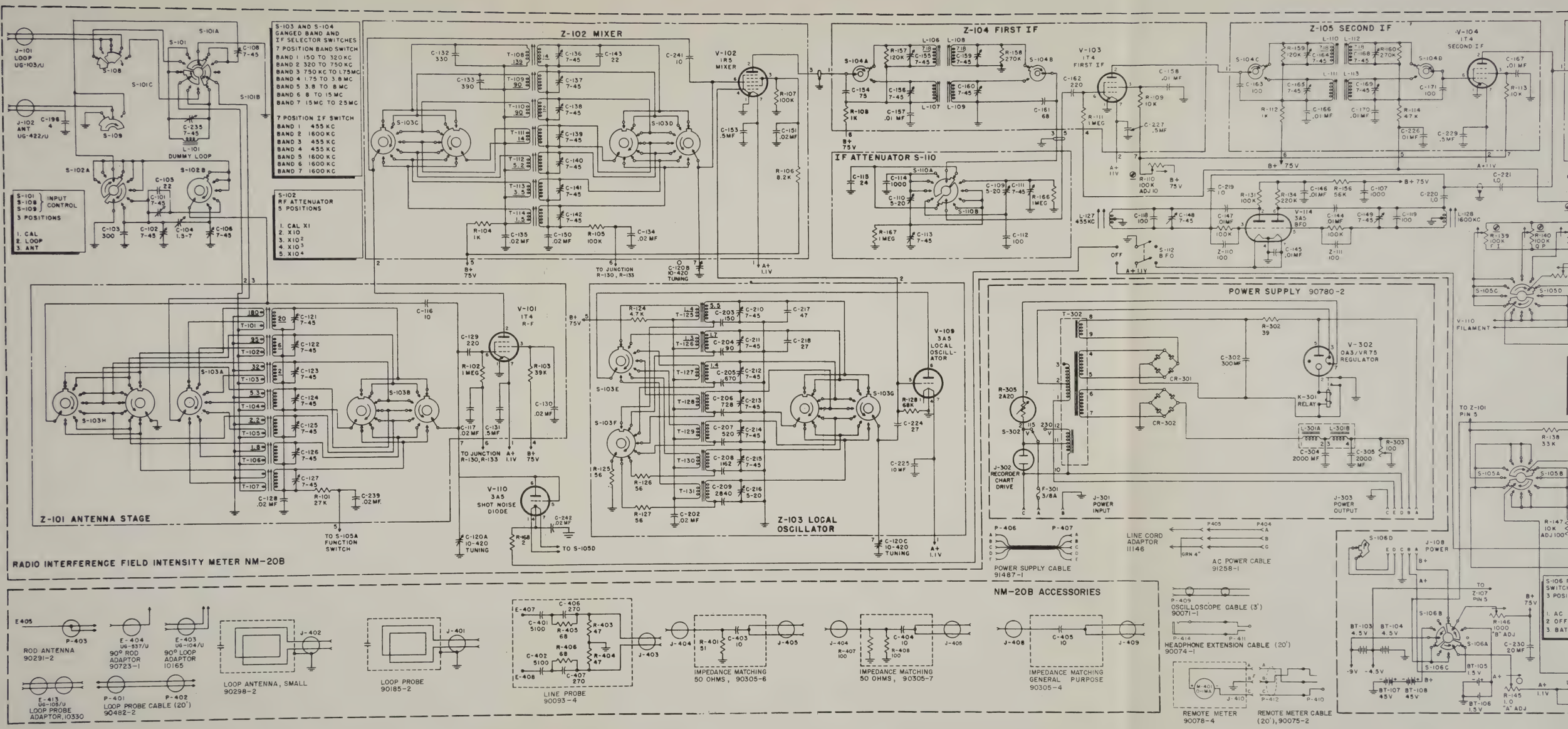
Step 15. Plot the points on the effective bandwidth curves of Chart #7 and #8, using the data recorded in step 13. Draw a smooth curve through the plotted points. Only one point in the center of the band is calibrated for Bands 4 through 7 because the curve for these bands is a straight line.

TABLE 5-1 ELECTRON TUBE OPERATING VOLTAGES

SYMBOL	TUBE	FUNCTION	PLATE VOLTS	SCREEN VOLTS	GRID VOLTS	FILAMENT VOLTS
V101	1T4	RF Amplifier	75	47.5	-0.2	1.1
V102	1R5	Mixer	75	** 40-50	-0.4	1.1
V103	1T4	1st IF Amplifier	75	63	0	1.1
V104	1T4	2nd IF Amplifier	75	62	-0.1	1.1
V105	1T4	3rd IF Amplifier	75	60	***	1.1
V106	3V4	4th IF Amplifier	75	72	-3.0	1.1
V107	3A5	2nd Detector	0	--	0	1.1
V108	1U5	1st Audio	30	15	0	1.1
V109	3A5	Local Oscillator	75	--	0	1.1
V110*	3A5	Calibrator	75	--	0	1.1
V111	3V4	VTVM	50	50	-0.1	1.1
V112	3V4	VTVM	50	50	-0.6	1.1
V113	3V4	Audio Output	70	75	****	1.1
V114	3A5	Beat Frequency Oscillator	15	--	-0.1	1.1
V301	2A20	Regulator	31 volts ac measured from pin 2 to pin 7			
V302	0A3/VR75	Regulator	75 volts from pin 5 to ground (nominal)			

* Function switch at DIODE position.
** Varies between Band 1 and Band 7.

*** -0.1 to -9.0
**** -0.25v with 20,000 ohms per volt meter
or 4.5v with VTVM


RADIO INTERFERENCE FIELD INTENSITY METER NM-20B
Z-101 ANTENNA STAGE
Z-102 MIXER
Z-103 LOCAL OSCILLATOR
Z-104 FIRST IF
Z-105 SECOND IF
IF ATTENUATOR S-110
POWER SUPPLY 90780-2
S-103 AND S-104 GANGED BAND AND IF SELECTOR SWITCHES
7 POSITION BAND SWITCH
BAND 1 150 TO 320 KC
BAND 2 320 TO 750 KC
BAND 3 750 KC TO 1.75 MC
BAND 4 1.75 TO 3.8 MC
BAND 5 3.8 TO 8 MC
BAND 6 8 TO 15 MC
BAND 7 15 MC TO 25 MC
7 POSITION IF SWITCH
BAND 1 455 KC
BAND 2 1600 KC
BAND 3 455 KC
BAND 4 455 KC
BAND 5 1600 KC
BAND 6 1600 KC
BAND 7 1600 KC
S-101 S-108 S-109 INPUT CONTROL
3 POSITIONS
1. CAL
2. LOOP
3. ANT
S-102 RF ATTENUATOR
5 POSITIONS
1. CAL X1
2. X10
3. X10²
4. X10³
5. X10⁴
V-101 1T4 R-F
V-102 1R5 MIXER
V-103 1T4 FIRST IF
V-104 1T4 SECOND IF
V-105 3A5 LOCAL OSCILLATOR
V-110 3A5 SHOT NOISE DIODE
V-114 3A5 BFO
V-302 0A3/VR75 REGULATOR
J-101 LOOP UG-103/U
J-102 ANT UG-422/U
L-101 DUMMY LOOP
TO JUNCTION R-130, R-133
TO S-105A FUNCTION SWITCH
TO S-105D
TO Z-101 PIN 5
TO Z-107 PIN 5
V-110 FILAMENT
J-302 RECORDER CHART DRIVE
J-301 POWER INPUT
J-303 POWER OUTPUT
J-108 POWER
CR-301
CR-302
K-301 RELAY
S-302
F-301 3/8A
POWER SUPPLY CABLE 91487-1
LINE CORD ADAPTOR 11146
AC POWER CABLE 91258-1
NM-20B ACCESSORIES
ROD ANTENNA 90291-2
90° ROD ADAPTOR 90723-1
90° LOOP ADAPTOR 10165
LOOP PROBE ADAPTOR, 10330
LOOP PROBE CABLE (20') 90482-2
LOOP ANTENNA, SMALL 90298-2
LOOP PROBE 90185-2
LINE PROBE 90093-4
IMPEDANCE MATCHING 50 OHMS, 90305-6
IMPEDANCE MATCHING 50 OHMS, 90305-7
IMPEDANCE MATCHING GENERAL PURPOSE 90305-4
OSCILLOSCOPE CABLE (3') 90071-1
HEADPHONE EXTENSION CABLE (20') 90074-1
REMOTE METER 90078-4
REMOTE METER CABLE (20'), 90075-2

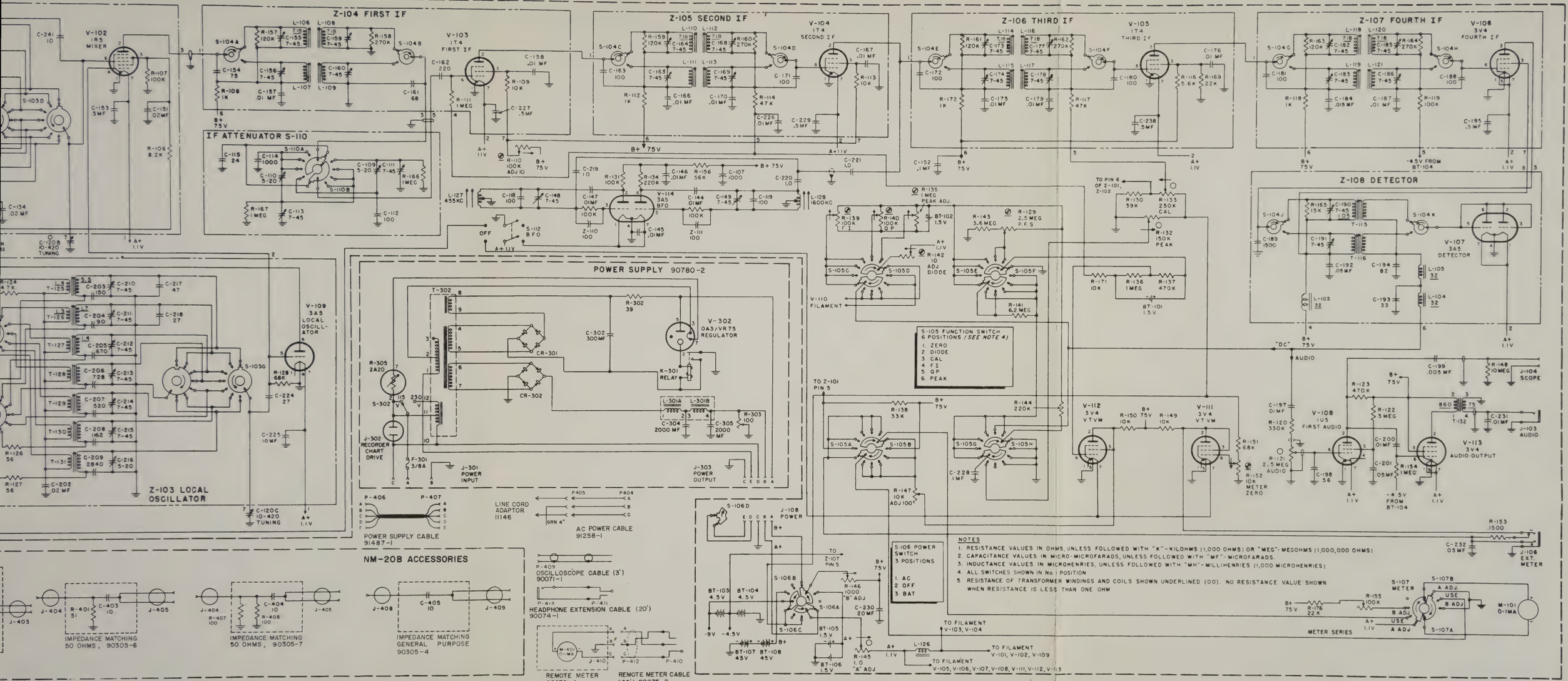

Z-104 FIRST IF
Z-105 SECOND IF
Z-106 THIRD IF
Z-107 FOURTH IF
Z-108 DETECTOR
V-102 1R5 MIXER
V-103 1T4 FIRST IF
V-104 1T4 SECOND IF
V-105 1T4 THIRD IF
V-106 3V4 FOURTH IF
V-107 3A5 DETECTOR
V-108 1U5 FIRST AUDIO
V-109 3A5 LOCAL OSCILLATOR
V-110 FILAMENT
V-111 3V4 VTVM
V-112 3V4 VTVM
V-113 3V4 AUDIO OUTPUT
IF ATTENUATOR S-110
POWER SUPPLY 90780-2
Z-103 LOCAL OSCILLATOR
S-105 FUNCTION SWITCH 6 POSITIONS (SEE NOTE 4)
1. ZERO
2. DIODE
3. CAL
4. FI
5. QP
6. PEAK
S-106 POWER SWITCH 3 POSITIONS
1. AC
2. OFF
3. BAT
NOTES
1. RESISTANCE VALUES IN OHMS, UNLESS FOLLOWED WITH "K"-KILOHMS (1,000 OHMS) OR "MEG"-MEGOHMS (1,000,000 OHMS)
2. CAPACITANCE VALUES IN MICRO-MICROFARADS, UNLESS FOLLOWED WITH "MF"-MICROFARADS.
3. INDUCTANCE VALUES IN MICROHENRIES, UNLESS FOLLOWED WITH "MH"-MILLIHENRIES (1,000 MICROHENRIES)
4. ALL SWITCHES SHOWN IN No. 1 POSITION
5. RESISTANCE OF TRANSFORMER WINDINGS AND COILS SHOWN UNDERLINED (00). NO RESISTANCE VALUE SHOWN WHEN RESISTANCE IS LESS THAN ONE OHM
NM-20B ACCESSORIES
POWER SUPPLY CABLE 91487-1
LINE CORD ADAPTOR 11146
AC POWER CABLE 91258-1
OSCILLOSCOPE CABLE (3') 90071-1
HEADPHONE EXTENSION CABLE (20') 90074-1
REMOTE METER 90078-4
REMOTE METER CABLE (20'), 90075-2
IMPEDANCE MATCHING 50 OHMS, 90305-6
IMPEDANCE MATCHING 50 OHMS, 90305-7
IMPEDANCE MATCHING GENERAL PURPOSE 90305-4
METER SERIES

FIG. 5-3 NM-20B RADIO INTERFERENCE-FIELD INTENSITY METER, SCHEMATIC DIAGRAM
(REPRINTED OCT. 14, 1963)

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
C101	CAPACITOR, variable; ceramic; 7 to 45 mmf; 450 vdcw	Ant. atten. at S102	CER CV11C450	10457
C102	Same as C101	Ant. atten. shunt at S102		
C103	CAPACITOR, fixed: mica; 300 mmf; 5%; 500 vdcw	Ant. atten. shunt at S102	CMF CM-20-301	10152-301
C104	CAPACITOR, variable; ceramic; 1.5 to 7.0 mmf; 500 vdcw	Ant. atten. series at S102	CER TS2A	10238
C105	CAPACITOR, fixed; mica; 22 mmf; 5%; 500 vdcw	Ant. atten. series at S102	CD CM20C220J	10152-220
C106	Same as C101	Ant. atten. shunt at S102		
C107	CAPACITOR, fixed; ceramic; 1000 mmf; 20%; 500 vdcw	Plate supply bypass	Mucon S-1	10453-102
C108	Same as C101	Dummy ant. at S101		
C109	CAPACITOR, variable: ceramic; 5 to 20 mmf; 500 vdcw	IF atten.series at first IF stage	CER N300TS2A	10098
C110	Same as C109	IF atten.series at first IF stage		
C111	Same as C101	IF atten. resonating at first IF stage		
C112	CAPACITOR, fixed: mica; 100 mmf; 5%; 500 vdcw	IF atten. shunt at first IF stage	CD CM20C101J	10152-101
C113	Same as C101	IF atten. resonating at first IF stage		
C114	CAPACITOR, fixed: mica; 1000 mmf; 5%; 500 vdcw	IF atten. shunt at first IF stage	CD CM20C102J	10152-102
C115	CAPACITOR, fixed: 24 mmf; 5%; 500 vdcw	IF atten. compensating at first IF stage	CD CM20C-240J	10152-240
C116	CAPACITOR, fixed: mica; 10 mmf; 10%; 500 vdcw	Ant. coupling	CD CM20B-100K	10151-100
C117	CAPACITOR, fixed: paper; 20,000 mmf; GMV. tol; 450 vdcw	V101 bias supply filter	CER 817	10493
C118	CAPACITOR, fixed: ceramic; 100 mmf; 500 vdcw	BFO tuning capacitor, 455KC	CASU Style CN	10451-101
C119	Same as C118	BFO tuning capacitor, 1600 KC		
C120	CAPACITOR, variable: air dielectric; 3 sect; 10 mmf to 420 mmf per ea. sect.	Ganged tuning capacitor for RF, osc. and mixer stages	CRK series 17 Type K	10240

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
C121	Same as C101	Ant. secondary trimmer, Band 1		
C122	Same as C101	Ant. secondary trimmer, Band 2		
C123	Same as C101	Ant. secondary trimmer, Band 3		
C124	Same as C101	Ant. secondary trimmer, Band 4		
C125	Same as C101	Ant. secondary trimmer, Band 5		
C126	Same as C101	Ant. secondary trimmer, Band 6		
C127	Same as C101	Ant. secondary trimmer, Band 7		
C128	Same as C117	V110 plate return by-pass		
C129	CAPACITOR, fixed: mica; 220 mmf; 10%; 500 vdcw	Ant. grid coupling	CD CM20B221K	10112-221
C130	Same as C117	V101 screen by-pass		
C131	CAPACITOR, fixed: paper; 10 mfd; +50 -15% tol; 25 vdcw; tantalum dielectric	V101 filament by-pass	CATD PP10B25A2	10459
C132	CAPACITOR, fixed: mica; 330 mmf; 5%; 500 vdcw	Mixer primary resonating, Band 1	CD KR-1327	10152-331
C134	Same as C117	Bias filter		
C135	Same as C117	V101 plate return by-pass		
C136	Same as C101	Mixer secondary trimmer, Band 1		
C137	Same as C101	Mixer secondary trimmer, Band 2		
C138	Same as C101	Mixer secondary trimmer, Band 3		
C139	Same as C101	Mixer secondary trimmer, Band 4		
C140	Same as C101	Mixer secondary trimmer, Band 5		
C141	Same as C101	Mixer secondary trimmer, Band 6		
C142	Same as C101	Mixer secondary trimmer, Band 7		
C143	Same as C105	RF padder, Band 1		

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
C144	CAPACITOR, Fixed: ceramic; 10,000 mmf; minus 20%, plus 80%; 150 vdcw	BFO DC blocking	CBN DM-103	10450-103
C145	Same as C144	BFO Filter by-pass		
C146	Same as C144	BFO plate supply by-pass		
C147	Same as C144	BFO DC blocking		
C148	Same as C101	BFO 455 kc trimmer		
C149	Same as C101	BFO 1600 kc trimmer		
C150	Same as C117	V102 grid return by-pass		
C151	Same as C117	V102 screen by-pass		
C152	CAPACITOR, fixed: ceramic; .1 mfd; -20%+80%; 600 vdcw	B+ 75v filter	CBN #DF-104	10442
C153	Same as C131	V102 filament by-pass		
C154	CAPACITOR, fixed; mica; 75 mmf; 5%; 500 vdcw	V102 plate resonating	CD CM20C-750J	10152-750
C155	Same as C101	455 kc trimmer		
C156	Same as C101	1600 kc trimmer		
C157	CAPACITOR, fixed: ceramic; disc-shaped; .01 mfd;450 vdcw	V102 plate return by-pass	CBN #BN	10369
C158	Same as C157	V103 screen coupling		
C159	Same as C101	455 kc trimmer		
C160	Same as C101	1600 kc trimmer		
C161	CAPACITOR, Fixed: mica; 68 mmf 5%; 500 vdcw	V103 grid circuit resonating	CD CM20C680	10152-680
C162	Same as C129	V103 grid coupling		
C163	Same as C112	V103 plate circuit resonating		
C164	Same as C101	455 kc trimmer		
C165	Same as C101	1600 kc trimmer		
C166	Same as C157	V103 plate supply by-pass		
C167	Same as C157	V104 screen by-pass		

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
C168	Same as C101	455 kc trimmer		
C169	Same as C101	1600 kc trimmer		
C170	Same as C157	V104 grid return by-pass		
C171	Same as C112	V104 grid circuit resonating		
C172	Same as C112	V104 plate resonating		
C173	Same as C101	455 kc trimmer		
C174	Same as C101	1600 kc trimmer		
C175	Same as C157	V104 plate by-pass		
C176	Same as C157	V105 screen by-pass		
C177	Same as C101	455 kc trimmer		
C178	Same as C101	1600 kc trimmer		
C179	Same as C157	V105 grid return by-pass		
C180	Same as C112	V105 grid resonating		
C181	Same as C112	V105 plate resonating		
C182	Same as C101	455 kc trimmer		
C183	Same as C101	1600 kc trimmer		
C184	CAPACITOR, fixed: paper; 15,000 mmf; ±10%; 200 vdcw	V105 plate supply by-pass	CAMD type ME	10166
C185	Same as C101	455 kc trimmer		
C186	Same as C101	1600 kc trimmer		
C187	Same as C157	V106 grid return by-pass		
C188	Same as C112	V106 grid resonating		
C189	CAPACITOR, fixed: mica; 1500 mmf; 1%; 500 vdcw	V106 plate resonating	CAW 1464	10241
C190	Same as C101	455 kc trimmer		
C191	Same as C101	V106 neutralizing		
C192	CAPACITOR, fixed: paper; 50,000 mmf; -10% +20%; 200 vdcw	V106 plate supply by-pass	CAMD ME type	10196

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
C193	CAPACITOR, fixed: mica; 33 mmf; 5%; 500 vdcw	V107 RF by-pass	CD CM20B330J	10153-330
C194	CAPACITOR, fixed: mica; 82 mmf; 10%; 500 vdcw	V107 RF by-pass	CD CM20B820K	10112-820
C195	CAPACITOR, fixed: paper, 500,000 mmf; +20%-10%; 100 vdcw	V106 filament by-pass	CAMD type ME	10159
C196	CAPACITOR, fixed: ceramic; 4 mmf; plus or minus 0.5 mmf; 500 vdcw	Rod antenna compensating	CER CC21SH040D	10226
C197	CAPACITOR, Fixed: paper; 10,000 mmf; minus 10% plus 20%; 200 vdcw	V108 audio coupling	CAMD ME	10146
C198	CAPACITOR, fixed; mica; 56 mmf; 10%; 500 vdcw	V108 grid by-pass	CD CM20B560K	10112-560
C199	CAPACITOR, fixed: paper 5000 mmf; minus 10% plus 20%; 300 vdcw	Coupling to J104	CAMD ME	10297
C200	Same as C197	V113 audio coupling		
C201	Same as C192	V108 screen by-pass		
C202	Same as C117	V109 plate by-pass		
C203	CAPACITOR, fixed: mica; 150 mmf; 1%; 500 vdcw	Osc. series padder, Band 1	CMF type 603M	10323
C204	CAPACITOR, fixed: mica; 90 mmf; 1%; 500 vdcw	Osc. series padder, Band 2	CMF type 603M	10324
C205	CAPACITOR, fixed: mica; 670 mmf; 1%; 500 vdcw	Osc. series padder, Band 3	CMF type 603M	10335
C206	CAPACITOR, fixed: mica: 728 mmf; 1%; 500 vdcw	Osc. series padder, Band 4	CMF type 603M	10327
C207	CAPACITOR, fixed: mica; 520 mmf; 1%; 500 vdcw	Osc. series padder, Band 5	CMF type 603M	10328
C208	CAPACITOR, fixed: mica; 1162 mmf; 1%; 500 vdcw	Osc. series	CMF type	10329
C209	CAPACITOR, fixed: mica; 2840 mmf; 1%; 500 vdcw	Osc. series padder, Band 7	CMF type 603J	10319
C210	Same as C101	Osc. trimmer, Band 1		
C211	Same as C101	Osc. trimmer, Band 2		
C212	Same as C101	Osc. trimmer, Band 3		
C213	Same as C101	Osc. trimmer, Band 4		

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
C214	Same as C101	Osc. trimmer, Band 5		
C215	Same as C101	Osc. trimmer, Band 6		
C216	Same as C109	Osc. trimmer, Band 7		
C217	CAPACITOR, fixed: mica; 47 mmf; 5%; 500 vdcw	Osc. parallel padder, Band 1	CD CM20C470J	10152-470
C218	CAPACITOR, fixed: mica; 27 mmf; 5%; 500 vdcw	Osc. parallel padder, Band 2	CD CM20C270J	10152-270
C219	CAPACITOR, fixed: ceramic; 1.0 mmf; 20%; 500 vdcw	BFO 455 kc injection	CAUZ JP-5/32	10367
C220	Same as C219	BFO 1600 kc injection		
C221	Same as C219	Oscillator injection		
C222	Not used			
C223	Not used			
C224	Same as C218	V109 grid coupling		
C225	Same as C131	V109 filament by-pass		
C226	Same as C157	V104 bias supply filter		
C227	Same as C195	V103 filament by-pass		
C228	CAPACITOR, fixed: paper; 100,000 mmf; minus 10% plus 20%; 400 vdcw	AVC filter	CAMD type ME	10101
C229	Same as C195	V104 filament by-pass		
C230	CAPACITOR, fixed: electrolytic; 20 mfd; 5%; 150 vdcw	B+line	CD CE63C200J	10233-200
C231	Same as C197	Audio output by-pass		
C232	Same as C192	External meter filter at J106		
C233	Not used			
C234	Not used			
C235	Same as C101	Dummy loop trimmer		
C236	Not used			
C237	Not used			

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
C238	Same as C195	V105 filament by-pass		
C239	Same as C117	Shot noise diode V110 filter capacitor		
C240	Not used			
C241	Same as C116	V102 RF coupling		
C242	Same as C117	V110 filament by-pass		
C243 thru C301	Not used			
C302	CAPACITOR, fixed: electrolytic; 300 mfd; 150 vdcw	Plate voltage supply filter	CSF 14548	10273
C303	Not used			
C304	CAPACITOR, fixed: electrolytic; 2,000 mfd; 15 vdcw	Filament voltage supply filter	CSF 14985	10275
C305	Same as C304	Filament voltage supply filter		
C306 thru C400	Not used			
C401	CAPACITOR, fixed: mica 5,100 mmf; 5%; 2500 vdcw	E-406 line probe	CD CM50B512J	10127-512
C402	Same as C401	E-406 line probe		
C403	CAPACITOR, fixed: ceramic; dielectric; 10 mmf; 5%; 500 vdcw	Matching network 50 ohms	CER CC21SL100J	10305
C404	Same as C403	Matching network 20 ohms		
C405	Same as C403	Matching network general purpose		
C406	CAPACITOR, fixed: mica; 270 mmf; 10%; 500 vdcw	Line probe	CD CM20B271K	10151-271
C407	Same as C406	Line probe		
CR301	Rectifier, metallic	B supply rectifier	CAFQ 8JI	10276
CR302	Rectifier, metallic	A supply rectifier	CAFQ Q1B1S5A	10277
E403	CONNECTOR, adapter: UG104/U	Loop adapter	CPH 83-22AP	10165
E404	CONNECTOR, adapter UG537/U	Rod antenna adapter	CADV 90723-1	90723-1

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
E413	CONNECTOR, adapter UG105/U	Loop probe connector	CPH	10330
F301	FUSE, cartridge: 3/8 amp	AC line fuse	CFA AGC 3/8	10289
F302	Same as F301	AC line fuse		
J101	CONNECTOR, receptacle: UG103/U	Loop input		10413
J102	CONNECTOR, receptacle: UG422/U	Antenna input	CARO 6225	90747-1
J103	JACK, telephone	Headphone jack	CMA JK-34A	10122
J104	CONNECTOR, receptacle	Conn. for osc.	CADV 10309	10309
J105	Not used			
J106	JACK, telephone	Jack for milli-ammeter rec.	CBIM 2J-1047A	10123
J107	Not used			
J108	CONNECTOR, receptacle	Power connector	CED CA3102E-14S 5P	11178
J109 thru J300	Not used			
J301	CONNECTOR, receptacle	Power input connector	CED CA3102E-14S -7P	11180
J302	CONNECTOR, receptacle	Recorder chart drive connector	CPH 97-4085	10156
J303	CONNECTOR, receptacle	Power output connector	CED CA3102E-14S -5S	11179
J304 thru J400	Not used			
J401	CONNECTOR, receptacle	Loop probe connector	CADV 10223	10223
J402	CONNECTOR, receptacle	Loop antenna connector	CPH	10163
J403	Same as J101	Line probe Connector		
J404	CONNECTOR, receptacle	50 ohm matching impedance	CADV 90720-1	90720-1
J405	CONNECTOR, receptacle	50 ohm matching imp. connector	CADV 10216	10216
J406	Not used	20 ohm matching impedance conn.		
J407	Not used	20 ohm matching impedance conn.		
J408	Same as J404	General purpose match. imp. conn.		

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
J409	Same as J405	General purpose match. imp. conn.		
J410	CONNECTOR, receptacle	Remote meter connector	CED 2054-3	10042
K301	RELAY, solenoid	B supply interlock	CLR 1010	10282
L101	COIL, RF: dummy antenna	Dummy loop	CADV 90264-1	90264-1
L102	Not used			
L103	COIL, RF: choke; 32 millihenries	RF choke, V107 plate	CADV 90209-1	90209-1
L104	Same as L103	RF choke at V107		
L105	Same as L103	RF choke at V107		
L106	COIL, RF: IF coil	455 kc winding	CADV 90205-1	90205-1
L107	COIL, RF: IF coil	1600 kc winding	CADV 90206-1	90206-1
L108	Same as L106	455 kc winding		
L109	Same as L107	1600 kc winding		
L110	Same as L106	455 kc winding		
L111	Same as L107	1600 kc winding		
L112	Same as L106	455 kc winding		
L113	Same as L107	1600 kc winding		
L114	Same as L106	455 kc winding		
L115	Same as L107	1600 kc winding		
L116	Same as L106	455 kc winding		
L117	Same as L107	1600 kc winding		
L118	Same as L106	455 kc winding		
L119	Same as L107	1600 kc winding		
L120	Same as L106	455 kc winding		
L121	Same as L107	1600 kc winding		
L122	Not used			
L123	Not used			
L124	Not used			
L125	Not used			
L126	COIL, RF: choke	Filter for A plus supply	CADV 90292-1	90292-1

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
L127	COIL, RF: BFO	BFO 455 kc RF coil	CADV 90734-1	90734-1
L128	COIL, RF: BFO	BFO 1600 kc RF coil	CADV 90735-1	90735-1
L129 thru L300	Not used			
L301	REACTOR, filter choke	A supply filter choke	CADV 10281	10281
M101	METER, multi-scale DC; 0-1 ma	Microvolt and db meter	CV 269	10443
P401	CONNECTOR, plug	Loop cable connector	CPH 83-22SP	10072
P402	Same as P401	Loop cable connector		
P403	Same as J405	Connector for rod antenna		
P404	CONNECTOR, plug	AC power cable connector	CADV 11136	11136
P405	CONNECTOR, plug assembly	AC power cable connector	CADV 10944	10944
P406	CONNECTOR, plug	Power supply cable connector	CED CA3106F-14S-5P	11177
P407	CONNECTOR, plug	Power supply cable connector	CED CA3106F-14S-5S	11176
P408	Not used			
P409	CONNECTOR, plug	Oscilloscope cable connector	CARO 3100	10228
P410	PLUG, telephone	Remote meter cable connector	CRL PJ-068	10088
P411	PLUG, telephone	Headphone ext. cable connector	CRL PJ-055B	10089
P412	CONNECTOR, plug	Remote meter cable connector	CED 2072-4	10069
P413	Not used			
P414	JACK, telephone	Headphone ext. cable connector	CMA 100A	10087
R101	RESISTOR, fixed: 27,000 ohms; 5%; 1/2 w	Current limiting resistor	CBZ EB-2735	10011-273
R102	RESISTOR, fixed: 1 megohm; 5%; 1/2 w	V101 grid bias	CBZ EB-1055	10011-105
R103	RESISTOR; fixed: 39,000 ohms; 5%; 1/2 w	V101 screen supply	CBZ EB-3935	10011-393

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
R104	RESISTOR, fixed: 1000 ohms; 5%; 1/2 w	V101 plate supply	CBZ 1025	10011-102
R105	RESISTOR, fixed: 100,000 ohms; 5%; 1/2 w	V102 grid bias	CBZ 1045	10011-104
R106	RESISTOR, fixed: 8200 ohms; 5%; 1/2 w	V102 screen	CBZ EB-8225	10011-822
R107	Same as R105	V102 screen bleeder		
R108	Same as R104	V102 plate supply		
R109	RESISTOR, fixed: 10,000 ohms; 5%; 1/2 w	V103 screen control	CBZ EB-1035	10011-103
R110	RESISTOR, variable: 100,000 ohms; 10%; 2 w	V103 screen control	CBZ type J	10242
R111	Same as R102	V103 grid bias		
R112	Same as R104	V103 plate supply		
R113	Same as R109	V104 screen supply		
R114	RESISTOR, fixed: 47,000 ohms; 5%; 1/2 w	V104 grid bias	CBZ EB-4735	10011-473
R115	Not used			
R116	RESISTOR, fixed: 5600 ohms; 5%; 1/2 w	Third IF primary load	CBZ EB-5625	10011-562
R117	Same as R114	V105 grid bias		
R118	Same as R104	V105 plate supply		
R119	Same as R105	V106 grid bias		
R120	RESISTOR, fixed: 330,000 ohms; 5%; 1/2 w	V108 grid filter	CBZ EB-3345	10011-334
R121	RESISTOR, variable: 2.5 megohms; 10%; 2 w	Audio gain	CBZ type J	10243
R122	RESISTOR, fixed: 3 megohms; 5%; 1/2 w	V108 screen supply	CBZ EB-3055	10011-305
R123	RESISTOR, fixed: 470,000 ohms; 5%; 1/2 w	V108 plate supply	CBZ EB-4745	10011-474
R124	RESISTOR, fixed: 4700 ohms; 5%; 1/2 w	Damping res. at V109 plate	CBZ EB-4725	10011-472
R125	RESISTOR, fixed: 56 ohms; 5%; 1/2 w	Parasitic suppressor at S103F	CBZ 5605	10011-560
R126	Same as R125	Parasitic suppressor at S103F		

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
R127	Same as R125	Parasitic suppressor at S103F		
R128	RESISTOR, fixed: 68,000 ohms; 5%; 1/2 w	V109 grid bias	CBZ EB-6835	10011-683
R129	RESISTOR, variable: 2.5 megohms; 10%; 2 w	Peak adjustment full scale V107 weighting	CBZ type J	10244
R130	Same as R103	Bias for V101, V102		
R131	Same as R105	V114 plate load		
R132	RESISTOR, variable: 150,000 ohms; 10%; 2 w	Peak adjustment V107 weighting	CBZ type J	10245
R133	RESISTOR, variable, 250,000 ohms; 10%; 2 w	CAL gain	CBZ type J	10246
R134	RESISTOR, fixed: 220,000 ohms; 5%; 1/2 w	BFO plate dropping	CBZ EB-2245	10011-224
R135	RESISTOR, variable: 1 megohm; 10%; 2 w	Peak adjustment control	CBZ type J	10247
R136	Same as R102	Voltage divider across BT101		
R137	Same as R123	Voltage divider across BT101		
R138	RESISTOR, fixed: 33,000 ohms; 5%; 1/2 w	Meter shunt at S105	CBZ EB-3335	10011-333
R139	Same as R110	FI control V107 weighting		
R140	Same as R110	Quasi-Peak control V107 weighting		
R141	RESISTOR, fixed: 6.2 megohms; 5%; 1/2 w	AVC filter	CBZ EB-6255	10011-625
R142	RESISTOR, variable: wire-wound; 10 ohms; 10%; 2 w	Diode V110 Adjustment control	CMC Series 43	10248
R143	RESISTOR, fixed: 3.6 megohms; 5%; 1/2 w	Diode V107 load	CBZ EB-3655	10011-365
R144	Same as R134	Diode V107 load		
R145	RESISTOR, variable: wire-wound; 1 ohm; 10%; 2 w	"A" supply adjust. control	CMC Series 43	10249
R146	RESISTOR, variable: 1000 ohms; 10%; 2 w	"B" supply adjust. control	CBZ type J	10251
R147	RESISTOR, variable: 10,000 ohms; 10%; 2 w	VTVM V112 plate	CBZ type J	10252
R148	RESISTOR, fixed: 10 megohms; 5%; 1/2 w	J104 loading	CBZ EB-1065	10011-106

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
R149	Same as R109	V111 plate		
R150	Same as R109	V112 plate		
R151	Same as R128	V111 bias		
R152	Same as R147	V111 bias		
R153	RESISTOR, fixed: 1500 ohms; 5%; 1/2 w	External meter compensating at J106	CBZ EB-1525	10011-152
R154	Same as R102	V113 grid res.		
R155	Same as R110	Meter Multiplier		
R156	RESISTOR, fixed: 56,000 ohms; 5%; 1/2 w	Plate filter resistor	CBZ EB-5635	10011-563
R157	RESISTOR, fixed: 120,000 ohms; 5%; 1/2 w	1st IF primary load	CBZ EB-1245	10011-124
R158	RESISTOR, fixed: 270,000 ohms; 5%; 1/2 w	1st IF secondary load	CBZ EB-2745	10011-274
R159	Same as R157	2nd IF primary load		
R160	Same as R158	2nd IF secondary load		
R161	Same as R157	3rd IF primary load		
R162	Same as R158	3rd IF secondary load		
R163	Same as R157	4th IF primary load		
R164	Same as R158	4th IF secondary load		
R165	RESISTOR, fixed: 15,000 ohms; 5%; 1/2 w	Detector primary load	CBZ EB-1535	10011-153
R166	Same as R102	IF atten. at 1st IF		
R167	Same as R102	IF atten. at 1st IF		
R168	RESISTOR, fixed: wire-wound; 2 ohms; 5%; 1/2 w	V110 filament dropping res.	CIR BW-1/2	10307
R169	RESISTOR, fixed: 22,000 ohms; 5%; 1/2 w	V105 screen	CBZ EB-2235	10011-223
R170	Not used			
R171	Same as R109	Bias filter resistor at BT101		
R172	Same as R104	V104 plate supply		

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
R173	Not used			
R174	Not used			
R175	Not used			
R176	Same as R169	Meter series fixed resistance		
R177 thru R301	Not used			
R302	RESISTOR, fixed: 39 ohms; 5%; 1/2 w	Dropping res. at V302	CBZ EB-3905	10011-390
R303	RESISTOR, variable: wire-wound 100 ohms; 10%; 2 w	"A" supply adjustment	CMC Series 43	10473
R304	Not used			
R305	RESISTOR, thermal	Current limiter T-302 primary	CAGK 2A20	10469
R306 thru R400	Not used			
R401	RESISTOR, fixed: composition; 51 ohms; 5%; 1/2 w	Matching imped. Network 50 ohms	CBZ EB-5105	10011-510
R402	Not used			
R403	RESISTOR, fixed: 47 ohms; 5%; 1/2 w	Line probe balancing circuit resistor	CBZ EB-4705	10011-470
R404	Same as R403	Line probe balancing circuit resistor		
R405	RESISTOR, fixed: 68 ohms; 5%; 1/2 w	Line probe, balancing circuit resistor	CBZ EB-6805	10011-680
R406	Same as R405	Line probe balancing circuit resistor		
S101	SWITCH, rotary: 3 pole; 3 pos; 3 throws	Loop switch	COC type HC	10295
S102A	SWITCH SECTION, rotary	Antenna atten. sect.	COC type HC	10292
S102B	SWITCH SECTION, rotary	Antenna atten. sect.	COC type HC	10293
S103A	SWITCH SECTION, rotary	Band switch	COC type HC	10234
S103B	Same as S103A	Band switch		
S103C	Same as S103A	Band switch		

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
S103D	Same as S103A	Band switch		
S103E	Same as S103A	Band switch		
S103F	Same as S103A	Band switch		
S103G	Same as S103A	Band switch		
S103H	Same as S103A	Band switch		
S104A	SWITCH SECTION, rotary	IF selector 1st IF stage	COC type H	10258
S104B	SWITCH SECTION, rotary	IF selector, 1st IF stage	COC type H	10257
S104C	Same as S104A	IF selector, 2nd IF stage		
S104D	Same as S104B	IF selector, 2nd IF stage		
S104E	Same as S104A	IF selector, 3rd IF stage		
S104F	Same as S104B	IF selector, 3rd IF stage		
S104G	Same as S104A	IF selector, 4th IF stage		
S104H	Same as S104B	IF selector 4th IF stage		
S104J	Same as S104B	IF selector, detector stage		
S104K	Same as S104A	IF selector, detector stage		
S105	SWITCH, rotary	Function switch	COC type H	10296
S106	SWITCH, rotary	Power switch	COC type H	10291
S107	SWITCH, rotary	Meter-use switch	COC 41986-53F	10827
S108	SWITCH SECTION, rotary	Loop input switch	CADV 90262-1	90262-1
S109	SWITCH SECTION, rotary	Antenna input switch	CADV 90263-1	90263-1
S110	SWITCH SECTION, rotary	IF atten. sect. on 1st IF stage	COC type HC	10294
S111	DETENT, SWITCH: rotary	Detent for IF attenuator switch	COC 39787 -H	10302
S112	SWITCH, TOGGLE: DPDT	BFO on-off switch	CHH 20905 GH	10172
S113 thru S301	Not used			

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
S302	Same as S112	Power input switch		
T101	COIL, RF	Ant. coil winding, Band 1	CADV 90192-1	90192-1
T102	COIL, RF	Ant. coil winding, Band 2	CADV 90192-2	90192-2
T103	COIL, RF	Ant. coil winding, Band 3	CADV 90192-3	90192-3
T104	COIL, RF	Ant. coil winding, Band 4	CADV 90192-4	90192-4
T105	COIL, RF	Ant. coil winding, Band 5	CADV 90192-5	90192-5
T106	COIL, RF	Ant. coil winding, Band 6	CADV 90192-6	90192-6
T107	COIL, RF	Ant. coil winding, Band 7	CADV 90192-7	90192-7
T108	COIL, RF	Mixer coil winding, Band 1	CADV 90194-1	90194-1
T109	COIL, RF	Mixer coil winding, Band 2	CADV 90194-2	90194-2
T110	COIL, RF	Mixer coil winding, Band 3	CADV 90194-3	90194-3
T111	COIL, RF	Mixer coil winding, Band 4	CADV 90194-4	90194-4
T112	COIL, RF	Mixer coil winding, Band 5	CADV 90194-5	90194-5
T113	COIL, RF	Mixer coil winding, Band 6	CADV 90194-6	90194-6
T114	COIL, RF	Mixer coil winding, Band 7	CADV 90194-7	90194-7
T115	COIL, RF	455 kc detector winding	CADV 90212-2	90212-2
T116	COIL, RF	1600 kc detector winding	CADV 90213-2	90213-2
T117 thru T124	Not used			
T125	COIL, RF	Osc. coil winding, Band 1	CADV 90203-1	90203-1
T126	COIL, RF	Osc. coil winding, Band 2	CADV 90203-2	90203-2
T127	COIL, RF	Osc. coil winding, Band 3	CADV 90203-3	90203-3

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
T128	COIL, RF	Osc. coil winding, Band 4	CADV 90203-4	90203-4
T129	COIL, RF	Osc. coil winding, Band 5	CADV 90203-5	90203-5
T130	COIL, RF	Osc. coil winding, Band 6	CADV 90203-6	90203-6
T131	COIL, RF	Osc. coil winding, Band 7	CADV 90203-7	90203-7
T132	TRANSFORMER, AF	Audio output	CADV 10304	10304
T133 thru T301	Not used			
T302	TRANSFORMER, Power: filament and plate	Plate and filament supply	CADV 10349	10349
V101	TUBE, electron: 1T4	RF amplifier	CRC 1T4	1T4
V102	TUBE, electron: 1R5	Mixer	CRC 1R5	1R5
V103	Same as V101	1st IF		
V104	Same as V101	2nd IF		
V105	Same as V101	3rd IF		
V106	TUBE, electron 3V4	IF amplifier	CRC 3V4	3V4
V107	TUBE, electron 3A5	2nd detector	CRC 3A5	3A5
V108	TUBE, electron 1U5	1st audio	CRC 1U5	1U5
V109	Same as V107	Oscillator		
V110	Same as V107	Noise generator		
V111	Same as V106	VTVM		
V112	Same as V106	VTVM		
V113	Same as V106	Audio output		
V114	Same as V107	BFO		
V115 thru V301	Not used			
V302	TUBE, electron 0A3/VR75	B+ regulator	CRC 0A3	0A3/VR75
Z101	AMPLIFIER SUB ASSEMBLY	Ant. stage	CADV 90220-1	90220-1
Z102	AMPLIFIER SUB ASSEMBLY	Mixer stage	CADV 90230-1	90230-1
Z103	AMPLIFIER SUB ASSEMBLY	Osc. stage	CADV 90240-1	90240-1
Z104	AMPLIFIER SUB ASSEMBLY	1st IF stage	CADV 90218-3	90218-3
Z105	AMPLIFIER SUB ASSEMBLY	2nd IF stage	CADV 90222-3	90222-3

PARTS LIST: RADIO INTERFERENCE-FIELD INTENSITY METER

SYMBOL	DESCRIPTION	FUNCTION	MFR. NO.	STODDART NO.
Z106	AMPLIFIER SUB ASSEMBLY	3rd IF stage	CADV 90224-3	90224-3
Z107	AMPLIFIER SUB ASSEMBLY	4th IF stage	CADV 90226-4	90226-4
Z108	AMPLIFIER SUB ASSEMBLY	Detector stage	CADV 90228-4	90228-4

LIST OF MANUFACTURERS

DESIGNATION	MANUFACTURERS	ADDRESS
CADV	Stoddart Aircraft Radio Co., Inc.	6644 Santa Monica Blvd., Hollywood 38, Calif.
CAIS	Birtcher Corporation	5087 Huntington Drive, Los Angeles 32, Calif.
CAMD	Good-All Electric Mfg. Co.	Ogallala, Nebraska
CAN	Sangamo Electric Co.	1935 Funk Street Springfield, Illinois
CARO	Industrial Products Co.	Danbury, Connecticut
CASU	Electrical Reactance Corp.	Franklinville, New York
CATD	Fansteel Metallurgical Corp.	North Chicago, Illinois
CAW	Aerovox Corporation	740 Belleville Avenue New Bedford, Mass.
CBN	Centralab (Div. of Globe-Union)	Milwaukee, Wisconsin
CBZ	Allen-Bradley Company	136 W. Greenfield Ave., Milwaukee 4, Wisconsin
CD	Cornell-Dubilier Electric Corp.	1000 Hamilton Blvd., South Plainfield, N. J.
CEB	H. H. Eby, Inc.	4700 Stenton Avenue Philadelphia, Penna.
CER	Erie Resistor Corporation	644 West 12th Street Erie, Pennsylvania
CFA	Bussman Manufacturing Company	2536 W. University St., St. Louis 7, Missouri
CFT	Federal Telephone & Radio Corp.	200 Mount Pleasant Ave., Newark, New Jersey
CHH	Arrow-Hart & Hegeman Elec. Co.	Hartford, Connecticut
CIR	International Resistance Corp.	401 North Broad Street Philadelphia, Penna.
CLR	Leach Relay Company	5915 Avalon Blvd., Los Angeles, California
CMA	P. R. Mallory Company, Inc.	3029 East Washington St., Indianapolis, Indiana
CMC	Clarostat Manufacturing Company	Dover, New Hampshire
CMF	Electro-Motive Manufacturing Co.	Willimantic, Connecticut
COC	Oak Manufacturing Company	1260 N. Clybourne Avenue Chicago, Illinois
COM	Ohmite Manufacturing Company	4835 W. Flournoy Street Chicago, Illinois
CPH	American Phenolic Corporation	1830 South 54th Street Cicero, Illinois
CRK	Radio Condenser Company	Camden, New Jersey

LIST OF MANUFACTURERS

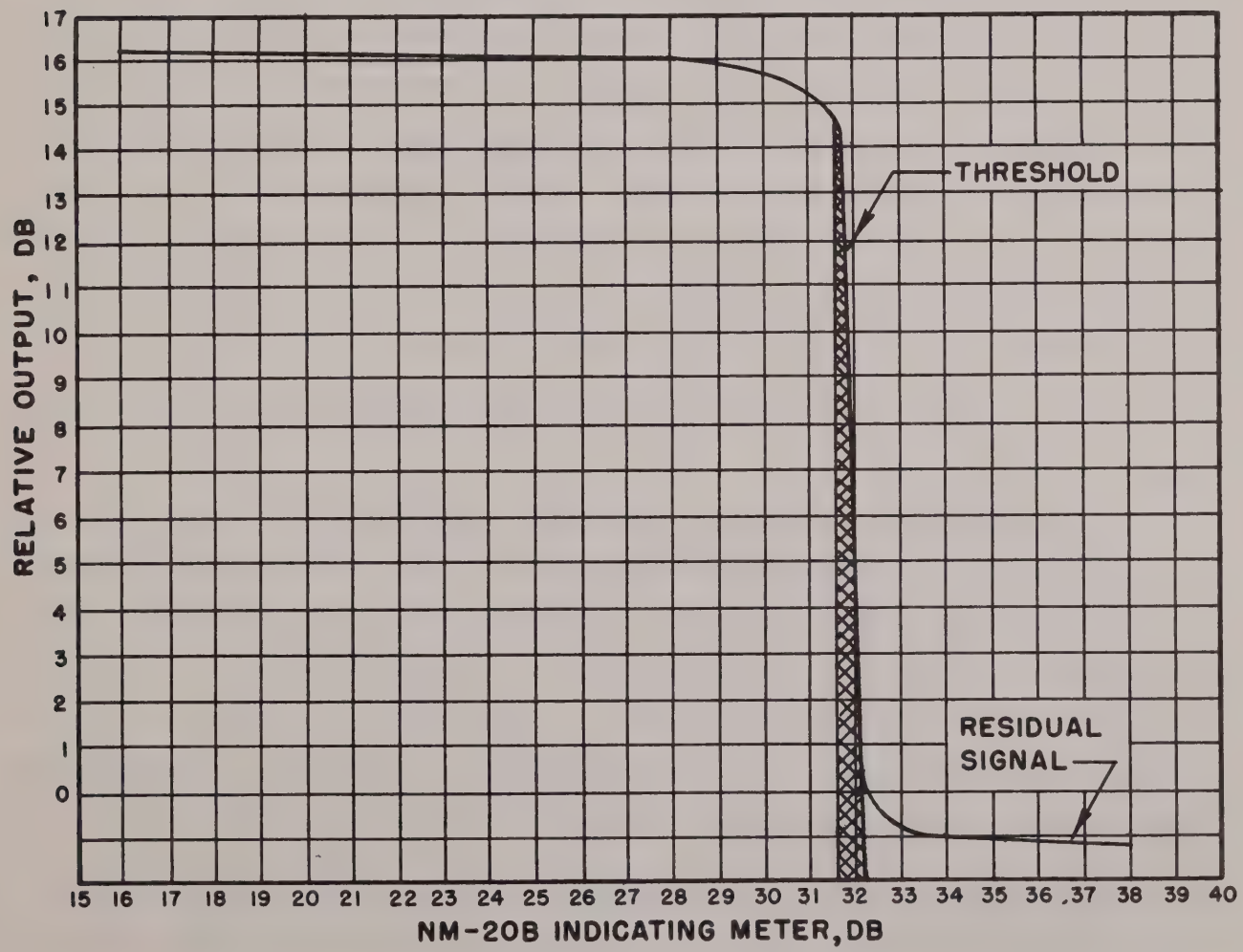
DESIGNATION	MANUFACTURERS	ADDRESS
CRL	Remler Company, Ltd.	2101 Bryant Street San Francisco, Calif.
CSF	Sprague Specialties Co.	North Adams, Mass.
CSV	Simpson Electric Company	5218 West Kinzie St., Chicago, Illinois
CV	Weston Electrical Instrument Corp.	614 Frelinghuysen Ave., Newark, New Jersey
CBIT	Mueller Electric Company	1583 East 31st Street Cleveland, Ohio
CBIM	Switchcraft, Inc.	1328-30 N. Halstead St., Chicago 22, Illinois

ADDITIONAL NOTES ON

NB-20B SLIDEBACK THRESHOLD INDICATION

1. Referring to the right-hand column of page 19 of the NM-20B instruction book, under Step 22, the instructions state "Slowly turn the PEAK control clockwise until the received headphone signal just becomes inaudible..." It seems to be this particular instruction which causes the trouble. Some operators are apparently attempting to remove all of the signal without realizing that a certain amount of residual signal is normal.

2. This situation can be illustrated with a signal of any type - modulated c-w, "random noise" or "impulse noise". Advancing the PEAK control clockwise and listening in the headphones (with the audio gain nearly wide open) we will hear something like this:



3. This is, of course, a simplified example. But, it shows quite clearly the effect that will be heard in the headphones. When the threshold is reached, the PEAK control is at the proper position - the correct amount of "slide-back" (bias) voltage has been applied to the plate of the second detector. No attempt should be made to remove the residual signal since this would result in erroneous meter indications. It will be found upon experimenting with the PEAK control that its clockwise rotation must be continued for a considerable distance past the threshold to completely eliminate the residual signal. This is what many operators are attempting to do.

4. While it is quite possible for an experienced operator to recognize the audible threshold point, we recommend that a visual technique be used whenever practical, even by experienced operators. This would include the use of either an output meter or an oscilloscope. Because of the additional controls on the oscilloscope which require adjustment and since a meter is simpler, the output meter method of indication is to be preferred.

5. Either the General Radio 583-A Output Power Meter or a multi-meter (such as the Triplett Model 630-A) may be used. The meter should be connected to the audio output jack of the NM-20B. The 10 db scale on the General Radio instrument, or the 12-volt scale and the "Output" terminals on the multi-meter should be used. With the audio gain well advanced, the threshold will be obvious as the PEAK control is rotated. The residual signal occuring beyond the threshold will cause only a very small deflection of the pointer.

6. If an oscilloscope is to be used as a threshold indicator, the procedure should be as follows:

Attach the Oscilloscope Cable (90071-1) to the vertical input terminals of the oscilloscope. Connect the termination on the opposite end of the cable to the SCOPE jack on the equipment. Adjust the 'scope for a very slow sweep and increase its gain (with no signal input to the NM-20B) until the hum from the NM-20B becomes just barely visible. With a signal applied to the input terminals of the NM-20B, it will be obvious when the PEAK control has reached the threshold point. The residual signal will be barely visible.

7. The threshold of an impulse signal of low repetition rate is the most difficult to determine. It is most obvious using the output meter method of indication.

8. It should be stressed again that the headphone method of indication is acceptable, provided, (a) the operator is experienced in the operation of the NM-20B, and (b) that he understands the proper operation of the PEAK control, approaches the threshold point carefully and does not exceed this point. Also, it is quite important to take into consideration the time lag in the PEAK control. It should be rotated slowly and carefully since the threshold point is fairly critical.

9. A and B voltages should be checked frequently during operation of the NM-20B. When calibrating the set, first check the A and B voltages with the audio control completely counterclockwise. With the Function switch in CAL position, adjust the CAL control to the point called for by the calibration chart. Then the A and B voltages should be readjusted, and the calibration repeated.

10. When using the PEAK function, check the A and B voltages when the threshold is reached. Readjust the voltages if necessary and re-establish the threshold.

RADIATION HAZARDS

IN RADIO INTERFERENCE MEASUREMENT

1. Biological damage from exposure to intense RF radiation has been known for several years but only recently have quantitative limits been established.

2. A tri-service limit for exposure to RF radiation has been established at .01 watts/cm^2 at any frequency. This is 194 volts/meter assuming linearly polarized plane waves. General Electric has proposed that a maximum safe limit of .001 watts/cm^2 (61 volts/meter) be used for continuous exposure and that .01 watts/cm^2 be an absolute maximum not to be exceeded except under emergency conditions.

3. It is possible that personnel operating Stoddart equipment will be exposed to power densities greater than .01 watts/cm^2. This will probably occur in locations where the rf field will not be linearly polarized plane waves such as the Fresnel Zone and in close proximity to magnetrons and klystrons.

4. It is suggested that before taking measurements near suspected or known strong radiation sources that reliable information on intensity be obtained.

Direct measurements of strong signal sources can be made with RI-FI equipment if the frequency is in the tuning range. Most RI-FI equipment does not have sufficient voltage range or shielding effectiveness to accurately measure to 194 volts/meter using standard antennas. In some situations, involving concentrated fields, the use of loop probes with their large antenna factors would enable approximate measurement. Limitations in RI-FI equipment shielding sometimes permits full scale meter indication when tuned to a very strong signal even with the antenna disconnected. Needless to say, the operator should be concerned when this occurs.

The following chart provides approximate equipment range limits (full scale) in volts/meter with and without pickup devices.

The equipment would be standardized for gain in accordance with instructions on the charts supplied. Then the input attenuator should be placed in the maximum position. Continuous wave signals would be measured in FI function switch position. Pulsed signals are measured with PEAK function.

STODDART NO. 40019-A

Equipment	Antenna	Approximate field strength volts/meter Equivalent radiation levels given in table below
NM-10A	Half meter rod	2
	30" loop (90117-2)	10
(14 kc to 250 kc)	6" loop (90114-2)	100
	Loop probe (90185-1)	1000*
	No antenna (or cable)	100 to 200
NM-20B	41" rod (90291-2)	2
	Loop antenna (90298-2)	.1
(150 kc to 25 mc)	Loop probe (90185-2)	10*
	No antenna (or cable)	20
NM-30A	Tuned dipole	1 to 50
	Loop antenna (90799-2)	170 to 500*
(20 mc to 400 mc)	No antenna (or cable)	10 to 500
NM-50	Tuned dipole	30 to 180
(375 mc to 1000 mc)	No antenna (or cable)	100 to 180

Field Strength volts/meter	Radiation Level watts/cm^2
0.1	0.265×10^{-8}
2.0	1.06×10^{-6}
10.	0.265×10^{-4}
20	1.06×10^{-4}
30	2.39×10^{-4}
50	6.63×10^{-4}
100	0.265×10^{-2}
170	0.766×10^{-2}
180	0.86×10^{-2}
200	1.06×10^{-2}
500	6.63×10^{-2}
1000	0.265

$$P = \frac{(E)^2}{120\pi} = .00265(E) \frac{2 \text{ watts}}{(\text{meter})^2}$$

P = Radiation Level

E = Field Strength - $\frac{\text{volts}}{\text{meter}}$

$$P \frac{(\text{watts})}{cm^2} = 10^{-4} \times P \frac{(\text{watts})}{(\text{meter})^2}$$

* Maximum measurement shown using loop probe antenna is only practical if RI-FI equipment is not exposed to strong RF field.

STODDART NO. 40019-A

ENGINEERING DEPT.
August 27, 1959

STODDART AIRCRAFT RADIO CO., INC.
6644 Santa Monica Boulevard
Hollywood 38, California

ADDENDUM
TO
INSTRUCTION BOOK FOR
MODEL NM-20B RADIO INTERFERENCE
AND FIELD INTENSITY METER

Additional instructions for use of the NM-20B in measuring radio interference according to specifications:

a. MIL-I-16910A (SHIPS)

b. MIL-I-26600 (USAF)

c. MIL-I-6181B

Procedure for measuring broadband interference by substitution method.

Procedure for determining broadband calibration settings.

STODDART NO. 40016-A

Revised 24 June 1959

		PAGE
1.	INTRODUCTION	1
2.	MEASURING BROADBAND INTERFERENCE WITH NM-20B EQUIPMENT	1
2.1	CONDUCTED MEASUREMENTS	1
2.1.1	In Terms of Microvolts-per-Kilocycle	1
2.1.2	In Terms of db Above One Microvolt-per-Megacycle Using LISN	2
2.1.3	In Terms of db Above One Micro-ampere-per-Megacycle Using Current Probe . .	3
2.2	RADIATED MEASUREMENTS	3
2.2.1	In Terms of Microvolts-per-Meter-per Kilocycle	3
2.2.2	In Terms of Antenna Inducted Microvolts-per-Kilocycle Bandwidth	4
2.2.3	In Terms of db Above One Microvolt-per-Megacycle Antenna Induced	5
3.	MEASURING BROADBAND INTERFERENCE BY SUBSTITUTION METHOD	6
	APPENDIX - PROCEDURE FOR DETERMINING BROADBAND CALIBRATION SETTINGS	8

STODDART NO. 40016-A

1. INTRODUCTION

The following material supplements SECTION 4, OPERATION and SECTION 5, paragraph 9, MAINTENANCE of the NM-20B instruction book.

The procedures presented in the following pages permits the measurement of broadband interference directly in the terms required by Military Specifications MIL-I-16910A(SHIPS), MIL-I-6181B and MIL-I-26600 (USAF) without involving bandwidth computations.

New calibration data called BROADBAND CALIBRATION SETTINGS is required in making these simplified measurements. The procedure for determining this calibration data is presented in APPENDIX I of this bulletin.

2. MEASURING BROADBAND INTERFERENCE WITH NM-20A OR NM-20B EQUIPMENT

2.1 CONDUCTED MEASUREMENTS

2.1.1 In Terms of Microvolts-Per-Kilocycle Applicable Military Specifications

(a) MIL-I-16910A(SHIPS)-30 August 1954- Figure 10 - "Broadband conducted interference expressed in terms of standard units."

(b) MIL-I-6181B - 29 May 1953 - Figure 19 - "Standard limits for broadband conducted interference."

NOTE

If the equipment is operated in accordance with the above specifications the 50 ohm matching network No. 90305-7 or No. 90305-6 must be used.

(1) Standardize the equipment gain at the test frequency, following the procedure in steps 1 through 9 on the first page of the NM-20B chart set except in Step 4 use the BROADBAND CALIBRATION SETTINGS.

(2) Take a PEAK (slideback) measurement of the broadband interference.

(3) Add the BANDWIDTH CORRECTION in db to the indicated reading (meter scale reading in db plus the attenuator setting in db). Subtract 60 db from this quantity. The result will be the peak value of the conducted signal in terms of db above one microvolt-per-kilocycle across 50 ohms. To convert to microvolts-per-kilocycle use conversion chart I.

STODDART NO. 40016-A

EXAMPLE

FREQUENCY	300 Kilocycles
BANDWIDTH CORRECTION	45 db
METER INDICATION	34 db
ATTENUATOR SETTING	40 db ($\times 10^2$)

Then, as outlined in step (3),

45 db + 34 db + 40 db - 60 db = + 59 db above one microvolt-per-kilocycle

Using conversion chart I we find broadband interference level to be,

880 microvolts-per-kilocycle

2.1.2 In Terms of db above one microvolt-per-megacycle using LISN Applicable Military Specification:

MIL-I-26600(USAF) - 2 June 1958 - Figure 3, "Broadband and Pulsed CW conducted interference limits using stabilization Network".

NOTE

If the equipment is operated in accordance with the above specification the 50 ohm matching network No. 90305-6 or No. 90305-7 must be used.

(1) Standardize the equipment gain at the test frequency, following the procedure in steps 1 through 9 on the first page of the NM-20B chart set except in step 4 use the BROADBAND CALIBRATION SETTINGS, as determined by the procedure of Appendix I.

(2) Take a PEAK (slideback) measurement of the broadband interference.

(3) Add the BANDWIDTH CORRECTION in db to indicated reading (meter scale reading in db plus the attenuator setting in db). The result will be the peak value of the conducted signal in terms of db above one microvolt-per-megacycle.

EXAMPLE

FREQUENCY	15 Megacycles
BANDWIDTH CORRECTION	35 db
METER INDICATION	40 db
ATTENUATOR SETTING	0 db (X1)

Then, as outlined in step (3),

35 db + 40 db + 0 db = +75 db above one microvolt-per-megacycle.

2.1.3 In Terms of "db above one Microampere-per-Megacycle" using Current Probe

Applicable Military Specification:

MIL-I-26600(USAF) - 2 June 1958 or

MIL-I-6181C(USAF) - 6 June 1957.

Figure 5, "Broadband and pulsed CW conducted interference limits using current probe".

Refer to the Instruction Book for Stoddart 91550-1 Current Probe for detailed conducted interference measurement procedure.

2.2 RADIATED MEASUREMENTS

2.2.1 In Terms of Microvolts-Per-Meter-Per-Kilocycle

Applicable Military Specification

MIL-I-16910A(SHIPS) - 30 August 1954 - Figure 7 - "Broadband Radiated Interference Limits - Expressed in terms of Standard Units."

NOTE

This procedure applies only when using a 41" rod antenna.

(1) Standardize the equipment gain at the test frequency, following the procedure in steps 1 through 9 on the first page of the NM-20B Chart Set except in step 4 use the BROADBAND CALIBRATION SETTINGS (Appendix I).

(2) Take a PEAK (slideback) measurement of the broadband interference.

(3) Add the BANDWIDTH CORRECTION in db to the indicated reading (meter scale reading in db plus the attenuator setting in db). Subtract 54 db* from this quantity. The result will be the peak value of the radiated interference in terms of db above one microvolt-per-meter-per-kilocycle. To convert to microvolts-per-meter-per-kilocycle use Chart I.

EXAMPLE

FREQUENCY	2 Megacycles
BANDWIDTH CORRECTION	35 db
METER INDICATION	24 db
ATTENUATOR SETTING	20 db (X10)

Then, as outlined in step (3),

35 db + 24 db + 20 db - 54 db = +25 db above one micro-volt-per-meter-per-kilocycle.

Using conversion chart 1 we find the broadband interference level to be 17.8 microvolts-per-meter-per-kilocycle.

2.2.2 In Terms of antenna induced Microvolts-per-Kilocycle Bandwidth

Applicable Military Specification:

MIL-I-6181B - 29 May ;953. Figure 16 - "Standard Limits broadband radiated interference."

NOTE

This procedure applies only when using a 41" rod antenna.

(1) Standardize the equipment gain at the test frequency, following the procedure in steps 1 through 9 on the first page of the NM-20B Chart Set except in step 4 use the

* 60 db is subtracted to convert the broadband measurement from micro-volts per megacycle to microvolts per kilocycle. Then 6 db is added to convert the half meter antenna (41") measurement to a one meter basis. Thus, minus 60 db plus 6 db equals minus 54 db.

BROADBAND CALIBRATION SETTINGS as determined in Appendix I.

(2) Take a PEAK (slideback) measurement of the broadband interference.

(3) Add the BANDWIDTH CORRECTION in db to the indicated reading (meter scale reading in db plus the attenuator setting in db). Subtract 60 db from the quantity. The result will be the peak value of the radiated interference in terms of db above one microvolt/kilocycle antenna induced. To convert to antenna induced microvolt/kilocycle bandwidth use Chart I.

EXAMPLE

FREQUENCY	20 Megacycles
BANDWIDTH CORRECTION	35 db
METER INDICATION	31 db
ATTENUATOR SETTING	0 db (X1)

Then, as outlined in step (3),

35 db + 31 db + 0 db - 60 db = +6 db above one microvolt/kilocycle antenna induced.

Using conversion Chart I we find the broadband radiated interference level to be, 2 antenna induced microvolts/kilocycle bandwidth.

2.2.3 In Terms of db above one Microvolt-Per-Megacycle Antenna Induced.

Applicable Military Specification:

MIL-I-26600(USAF) - 2 June 1958 - Figure 8, "Broadband and Pulsed CW Radiated Interference Limits."

NOTE

This procedure applies only when using a 41" rod antenna.

(1) Standardize the equipment gain at the test frequency, following the procedure in steps 1 through 9 on the first page of the NM-20B Chart Set except in step 4 use the BROADBAND CALIBRATION SETTINGS.

(2) Take a PEAK (slideback) measurement of the broadband interference.

(3) Add the BANDWIDTH CORRECTION in db to the indicated reading (meter scale reading in db plus the attenuator setting in db). The result will be the peak value of the radiated interference in terms of db above one microvolt-per-megacycle antenna induced.

EXAMPLE

FREQUENCY	500 Kilocycles
BANDWIDTH CORRECTION	45 db
METER INDICATION	15 db
ATTENUATOR SETTING	20 db (X10)

Then, as outlined in step (3),
45 db + 15 db + 20 db = +80 db above one microvolt-per-megacycle antenna induced.

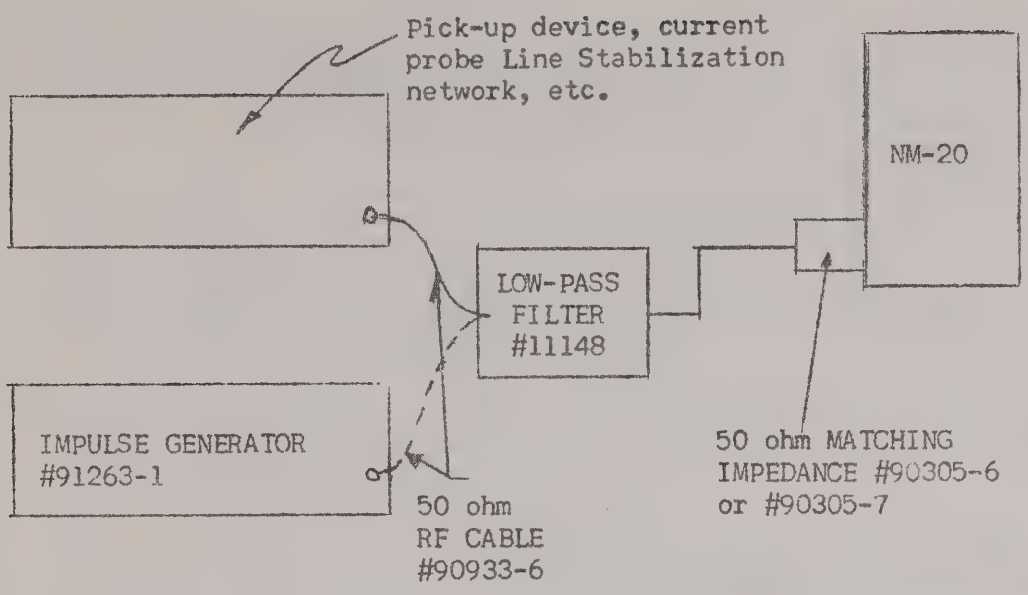
3. MEASURING BROADBAND INTERFERENCE BY SUBSTITUTION METHOD

Accuracy of measurement using this method is dependent on the impulse generator used as reference.

3.1 EQUIPMENT REQUIRED

Impulse Generator, Stoddart Aircraft Radio Co., Inc., Model No. 91263-1
Low Pass Filter, Stoddart Aircraft Radio Co., Inc., Model No. 11148
NM-20 Equipment with No. 90305-6 or No. 90305-7 50 ohm matching impedance
RF cable, 50 ohm coaxial, Stoddart No. 90933-6.

3.2 EQUIPMENT SETUP


Pick-up device, current probe Line Stabilization network, etc.
NM-20
LOW-PASS FILTER #11148
IMPULSE GENERATOR #91263-1
50 ohm MATCHING IMPEDANCE #90305-6 or #90305-7
50 ohm RF CABLE #90933-6

3.3 PROCEDURE

(1) Take a PEAK (slideback) measurement of the interference using the pick-up device. There is no need to standardize the gain of the NM-20 equipment. Note the output meter indication. DO NOT MOVE THE PEAK CONTROL again during this procedure.

(2) Transfer the RF Cable from the output of the pick-up device to the output of the impulse generator. Adjust output of the impulse generator for same NM-20 output meter indication noted in step (1).

(3) Record output of impulse generator in db above 1 microvolt-per-megacycle. This is the measurement of the broadband interference anc can be used as the "indicated reading" in step (3) of paragraph 2.1.1 and 2.1.2.

APPENDIX I

1. The following procedure is for determining BROADBAND CALIBRATION SETTINGS FOR NM-20A or NM-20B equipment which permit measuring broadband interference directly in terms of db above one microvolt-per-megacycle.

2. Equipment Required

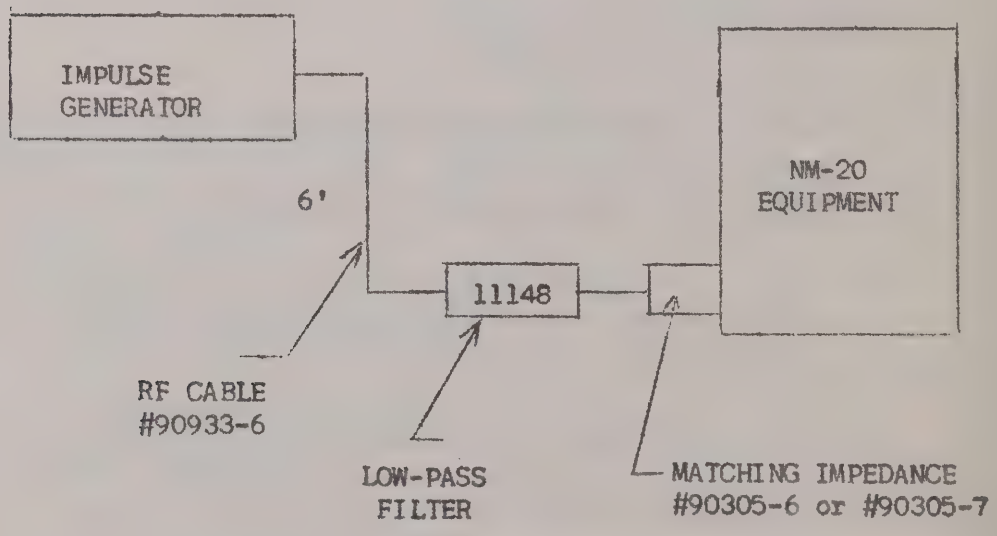
Impulse Generator - Stoddart No. 91263-1

Low-Pass Filter, 30 mc cut-off frequency - Stoddart No. 11148

RF cable, 50 ohm coaxial, Stoddart No. 90933-6.

50 ohm matching impedance - Stoddart No. 90305-6 or No. 90305-7.

3. Equipment Setup



4. Procedure

(1) Set NM-20B input switch to ANT. attenuator to (X10), function switch to PEAK, adjust the PEAK control for a meter indication of 20 db.

NOTE

For greatest accuracy check meter selector switch "A" ADJ and "B" ADJ frequently throughout the procedure.

(2) Tune the NM-20B equipment to calibrating frequency. Use a minimum of five frequencies across each band.

(3) Turn the impulse generator to "ON" position. Adjust the generator output to a REFERENCE LEVEL of 80 db above 1 microvolt-per-megacycle.

(4) Adjust "CAL" control until the threshold of the impulse noise is heard in the headphones or as indicated by other peak determining means.*

(5) Rotate input switch, attenuator switch, and function switch to "CAL" position. Observe the meter reading in db and record this level as the BROADBAND CALIBRATION SETTING.

(6) If the meter reading in (step 5) should go off scale, increase the impulse generator REFERENCE LEVEL in (step 3) 5 db. If the meter reading in (step 5) is in the lower portion of the meter scale, decrease the impulse generator REFERENCE LEVEL in (step 3) 5 db. Then repeat (steps 4 and 5). Use the same final impulse generator REFERENCE LEVEL for each calibrating frequency in any one band.

(7) Subtract 40 db from the final REFERENCE LEVEL of (step 6) and record the result in db as the BANDWIDTH CORRECTION. There will be one BANDWIDTH CORRECTION for each band.

(8) Plot the BROADBAND CALIBRATING SETTINGS as done in Charts 1 and 2 of the NM-20B calibration charts. Mark each band with the BANDWIDTH CORRECTION determined for it in (step 7).

* See Appendix II of Stoddart Bulletin entitled "Measurement of Radio Interference in accordance with Specification MIL-I-6181B using Stoddart NM-20A or NM-20B equipment".

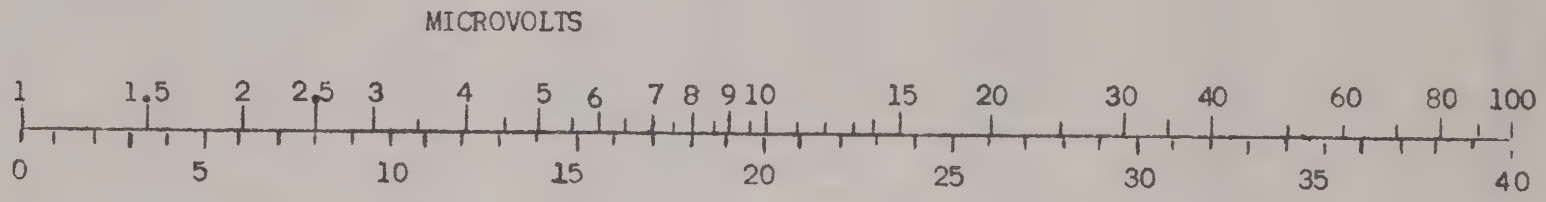
CONVERSION CHART - DECIBELS TO MICROVOLTS STODDART NO. 40016A

To convert from decibels to microvolts:

1. Locate the db value on the lower scale of the chart.
2. The equivalent microvolt value is found directly above on the microvolt scale.

To convert from microvolts to decibels:

1. Locate the microvolt value on the upper scale of the chart.
2. Equivalent db value is found directly below on the decibel scale.



To determine values other than those listed on chart:

Decibels: Subtract 20 db from the given value of decibels successively until the remainder can be found on the chart. Multiply the number of microvolts thus found by 10 for each time you Subtracted 20 db.

Microvolts: Divide the given microvolts by 10 successively until the remainder can be found on the chart. To the number of decibels thus found, add +20 db for each time you divided by 10.

ADDENDUM TO INSTRUCTION BOOK
FOR MODEL NM-20B
RADIO INTERFERENCE AND FIELD INTENSITY METER

Additional instructions for use of theNM-20B in measuring radio interference according to MIL-I-6181D:

Procedure for measuring broadband interference by substitution method.

Procedure for determining broadband calibration settings.

Revised January, 1966

STODDART NO. 40016B

NM-20B ADDENDUM

TABLE OF CONTENTS

PARA.		PAGE
1.0	INTRODUCTION	1
2.0	MEASURING BROADBAND INTERFERENCE WITH NM-20A OR NM-20B EQUIPMENT	1
2.1	Conducted Measurements	1
2.1.1	In Terms of DB Above One Microvolt-Per-Megacycle Using LISN Applicable Military Specification	1
2.1.2	In Terms of DB Above One Microampere-Per-Megacycle Using Current Probe	2
2.2	Radiated Measurements	2
2.2.1	In Terms of DB Above One Microvolt-Per-Megacycle Antenna Induced	3
3.0	MEASURING BROADBAND INTERFERENCE BY SUBSTITUTION METHOD	4
3.1	Equipment Required	4
3.2	Equipment Setup	4
3.3	Procedure	5
	APPENDIX I	6

1.0 INTRODUCTION

The following material supplements SECTION 4, OPERATION and SECTION 5, Paragraph 9, MAINTENANCE of the NM-20B Instruction Book.

The procedures presented in the following pages permits the measurement of broadband interference directly in the terms required by Military Specification MIL-I-6181D without involving bandwidth computations.

New calibration data called BROADBAND CALIBRATION SETTINGS is required in making these simplified measurements. The procedure for determining this calibration data is presented in APPENDIX I of this bulletin.

2.0 MEASURING BROADBAND INTERFERENCE WITH NM-20A OR NM-20B EQUIPMENT

2.1 Conducted Measurements

2.1.1 In Terms of Db Above One Microvolt-Per-Megacycle Using LISN Applicable Military Specification.- Broadband and pulsed Cw conducted interference limits using stabilization network, MIL-I-6181D, Figure 8.

NOTE

If the equipment is operated in accordance with the above specification, the 50 Ohm Matching Network, No. 90305-6 or No. 90305-7 must be used.

1. Standardize the equipment gain at the test frequency following the procedure in Steps 1 through 9 on the first page of the NM-20B Chart Set, except in Step 4,

STODDART NO. 40016B

use the BROADBAND CALIBRATION SETTINGS, as determined by the procedure of Appendix I.

2. Take a PEAK (slideback) measurement of the broadband interference.

3. Add the BANDWIDTH CORRECTION in Db to indicated reading (meter scale reading in Db plus the attenuator setting in Db). The result will be the Peak value of the conducted signal in terms of Db above one microvolt-per-megacycle.

EXAMPLE

Frequency	15 Megacycles
Bandwidth Correction	35 Db
Meter Indication	40 Db
Attenuator Setting	0 Db (X1)

Then as outlined in Step 3:

35 Db + 40 Db + 0 Db = +75 Db above one microvolt-per-megacycle.

2.1.2 In Terms of Db Above One Microampere-Per-Megacycle Using Current Probe.- Broadband and pulsed Cw conducted interference limits using current probe, MIL-I-6181D, Figure 10, refer to the instruction book for Stoddart No. 91550-1 Current Probe for detailed conducted interference measurement procedure.

2.2 Radiated Measurements

2.2.1 In Terms of Db Above One Microvolt-Per-Megacycle Antenna Induced.-Broadband and Pulsed Cw Radiated Interference Limits, MIL-I-6181D, Figure 16.

NOTE

This procedure applies only when using a 41" rod antenna.

1. Standardize the equipment gain at the test frequency following the procedure in Steps 1 through 9 on the first page of the NM-20B Chart Set, except in Step 4, use the BROADBAND CALIBRATION SETTINGS.

2. Take a PEAK (slideback) measurement of the broadband interference.

3. Add the BANDWIDTH CORRECTION in Db to the indicated reading (meter scale reading in Db plus the attenuator setting in Db). The result will be the Peak value of the radiated interference in terms of Db above one microvolt-per-megacycle antenna induced.

EXAMPLE

Frequency	500 Kilocycles
Bandwidth Correction	45 Db
Meter Indication	15 Db
Attenuator Setting	20 Db

Then as outlined in Step 3;

45 Db + 15 Db + 20 Db = 80 Db above one microvolt-per-megacycle antenna induced.

3.0 MEASURING BROADBAND INTERFERENCE BY SUBSTITUTION METHOD

Accuracy of measurement using this method is dependent on the impulse generator used as reference.

3.1 Equipment Required

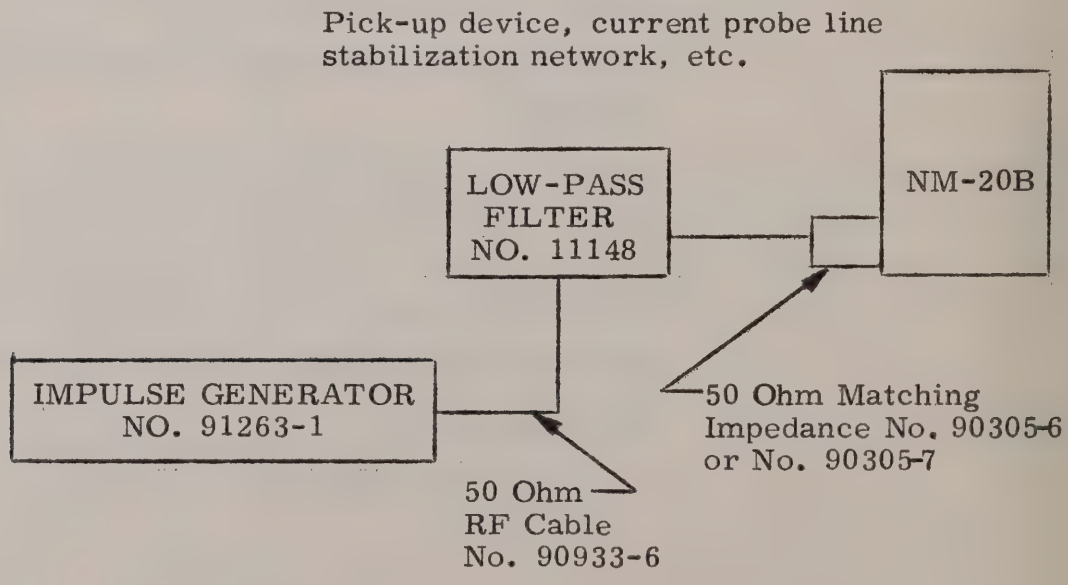
Impulse Generator, Stoddart Electro Systems, Model No. 91263-1

Low-Pass Filter, Stoddart Electro Systems, Model No. 11148

NM-20B Equipment with No. 90305-6 or No. 90305-7 50 Ohm Matching Impedance.

RF Cable, 50 Ohm Coaxial, Stoddart No. 90933-6.

3.2 Equipment Setup


Pick-up device, current probe line stabilization network, etc.
LOW-PASS FILTER NO. 11148
NM-20B
IMPULSE GENERATOR NO. 91263-1
50 Ohm Matching Impedance No. 90305-6 or No. 90305-7
50 Ohm RF Cable No. 90933-6

3.3 Procedure

1. Take a PEAK (slideback) measurement of the interference using the pick-up device. There is no need to standardize the gain of the NM-20B Equipment. Note the output meter indication. DO NOT MOVE THE PEAK CONTROL again during this procedure.

2. Transfer the RF Cable from the output of the pick-up device to the output of the impulse generator. Adjust output of the impulse generator for same NM-20B output meter indication noted in Step 1.

3. Record output of impulse generator in Db above one microvolt-per-megacycle. This is the measurement of the broadband interference and can be used as the "indicated reading" in Step 3 of Paragraph 2.1.1.

APPENDIX I

1. The following procedure is for determining BROADBAND CALIBRATION SETTINGS FOR NM-20A or NM-20B Equipment which permits measuring broadband interference directly in terms of Db above one microvolt-per-megacycle.

2. Equipment Required

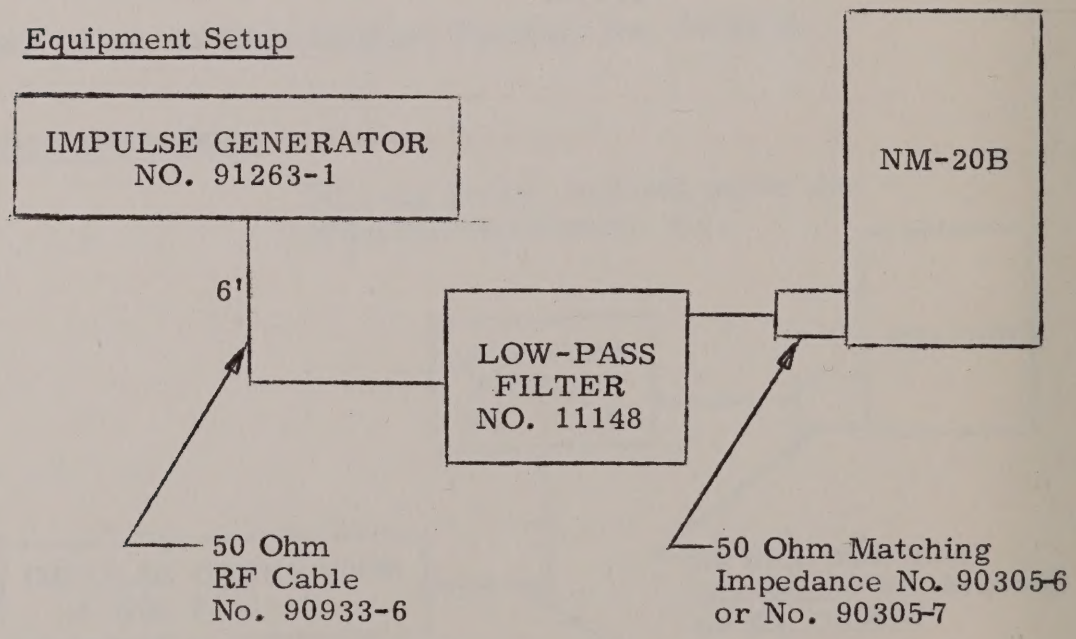
Impulse Generator, Stoddart Electro Systems No. 91263-1.

Low-Pass Filter, 30 Mc Cut-Off Frequency, Stoddart No. 11148.

RF Cable, 50 Ohm Coaxial, Stoddart No. 90933-6.

50 Ohm Matching Impedance, Stoddart No. 90305-6 or No. 90305-7.

3. Equipment Setup



4. Procedure

1. Set NM-20B Input Switch to ANT. attenuator to (X10), Function Switch to PEAK; adjust the PEAK control for a meter indication of 20 Db.

NOTE

For greatest accuracy, check meter selector switch "A" ADJ. and "B" ADJ. frequently throughout the procedure.

2. Tune the NM-20B Equipment to calibrating frequency. Use a minimum of five frequencies across each band.

3. Turn the impulse generator to "ON" position. Adjust the generator output to a REFERENCE LEVEL of 80 Db above one microvolt-per-megacycle.

4. Adjust CAL control until the threshold of the impulse noise is heard in the headphones or as indicated by other Peak determining means.*

5. Rotate input switch, attenuator switch, and function switch to CAL position. Observe the meter reading in Db and record this level as the BROADBAND CALIBRATION SETTING.

6. If the meter reading in Step 5 should go off scale, increase the impulse generator REFERENCE LEVEL in Step 3 to 5 Db. If the meter reading in Step 5 is

* See Appendix II of Stoddart Bulletin entitled, "Measurement of Radio Interference in accordance with Specification MIL-I-6181D using Stoddart NM-20A or NM-20B Equipment.

in the lower portion of the meter scale, decrease the impulse generator REFERENCE LEVEL in Step 3 to 5 Db. Then repeat Steps 4 and 5. Use the same final impulse generator REFERENCE LEVEL for each calibrating frequency in any one band.

7. Subtract 40 Db from the final REFERENCE LEVEL of Step 3 or Step 6 if used and record the result in Db as the BANDWIDTH CORRECTION. There will be one BANDWIDTH CORRECTION for each band.

8. Plot the BROADBAND CALIBRATING SETTINGS as done in Charts 1 and 2 of the NM-20B Calibration Charts. Mark each band with the BANDWIDTH CORRECTION determined for it in Step 7.